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MIDWIFERY

BY
TEN TEACHERS

UNDER THE DIRECTION OF
FREDERICK W. ROQUES

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PREFACE TO THE TENTH EDITION

IN preparing the tenth edition of this book the Editors have endeavoured to keep it in line with current obstetric opinion and recent advances by a very thorough revision of the text. The chapters on Abnormal Presentations, Diseases Associated with Pregnancy, Obstetric Operations and Cæsarean Section have been almost entirely re-written. Three new chapters have been added; an introductory chapter at the beginning and two chapters at the end dealing, respectively, with Blood-transfusion in Obstetrics and Vital Statistics. Re-writing and the new chapters have increased the size of the book by more than a hundred pages. Moreover many of the older figures have been replaced and new figures added.

Mr. Douglas Macleod has retired from the staff of contributors; his place has been filled by Mr. Robert Percival to whom we extend a hearty welcome.

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CHAPTER I

INTRODUCTION

“Of all the jobs undertaken by the medical profession midwifery is the most rewarding. Its aim is normality and if normality is achieved there is a glow of satisfaction on all those who have assisted the woman in her supreme fulfilment.” So wrote Stabler in 1959 and his words express what must have been felt by countless doctors and midwives over the centuries. During the last three or four decades, with the advent of prenatal care, the phrase “preservation of the normal” has indeed been fulfilled. Conscientious work in the weeks of pregnancy has not only preserved, or even helped to improve, the health of the mother, but also it has succeeded in foreseeing and perhaps preventing many difficulties or even disasters that would have arisen in the subsequent labour or puerperium. The benefits provided thereby to the mother must have been multiplied many times in the case of the infant.

One factor in the great improvement in recent years in the figures for maternal and perinatal mortality is the greater skill of the doctors who practice midwifery. For this there is more than one explanation, but it is probable that there is no item of greater importance than the emergence of a general appreciation by the medical profession itself of the supreme wisdom of postgraduate experience in midwifery before embarking on its domiciliary practice. Such experience is gained by holding a resident obstetric post for six months.

If, therefore, only a proportion of doctors are to practice obstetrics why is it necessary to include a period of so thorough training in midwifery in the curriculum of every medical student? This question has been asked many times, for under half of all those who qualify will enter general practice. The answer is quite simple. Pregnancy and labour constitute two matters of the greatest importance in the physiology of women. No man or woman who was not familiar with the subject could pretend to understand their female patients. Apart from this, midwifery may demand immediate medical aid and every doctor must surely be expected to be able to render at least sensible first aid measures until expert assistance can be summoned.

Nearly all medical students enjoy their period of training in the midwifery wards. At once, and perhaps for the first time, they feel that they are indeed active members of a team. Rapidly, too, comes the appreciation of Stabler's remarks quoted above. The obstetric

training is able to give the student some responsibility and this, together with his interest, stimulates enthusiasm. The results of prenatal work rapidly become apparent and these are especially seen in the benefits that follow the care taken to maintain the mother's general state of health. In the labour wards the student is able to put into practice the principles of surgical technique which have hitherto been theoretical for the most part. The personal responsibility of the student for the mother and her baby does not end in the labour ward for it should continue at least until they leave hospital to return home. The student will learn that the few days of in-patient stay not only allow the woman to recover from the ordeal of labour, which is most variable, but more important it enables her to become accustomed to a new set of circumstances, *i.e.* the arrival of another and important member of the family and all that that means. The student will learn to appreciate, probably for the first time, the strength of the maternal instinct, and concurrently too often the complete ignorance of the husband of all that his wife has gone through or of the part he should play in trying to help her.

Midwifery never goes to plan and certainly not in the time of arrival of the baby. All this goes to instil a sense of self-discipline and a better understanding of Medicine, spelt with a capital M. He will be able better to appreciate the skill and trials of the nursing staff with whom he works and will become familiar with the never ending activities of a hospital. Lastly, and perhaps it is due to enthusiasm, midwifery teaching almost universally is of the highest standard. That it is practical—it must be—is immediately apparent and the student finds he rapidly acquires a working knowledge of the subject.

The midwifery curriculum lasts at least 2 months and during the first 4 weeks the student should aim at reading through one not too lengthy textbook from cover to cover. Many old terms and words have been retained and he should be familiar with their meaning.

Interest in medicine is always furthered by history and especially so is this the case in midwifery. In addition it is advisable that the student should have some knowledge of the conditions under which, if he decides to practice midwifery, he is likely to work. It is proposed therefore to give a very brief account of the evolution of what are termed the Midwifery Services of Britain.

The art of midwifery has been practised in some form or another literally since the days of Adam and Eve and it is useful to remember, especially to those who have contact, and perhaps conflict, with that powerful and assertive body of women known as midwives, that the first "midwife" must have been a man. Be this as it may, from that early date women took over the task of supervising the birth of

babies. In this capacity they are mentioned six times in the book of Genesis and repeatedly throughout the Old Testament. The physician hardly enters the picture at all and then at a much later date. The surgeon is not mentioned.

Until the end of the last century, and indeed until the early years of the present one, the vast bulk of midwifery was done in the home. Nearly all confinements were domiciliary and nearly all babies were born under the care of an untrained or self-trained woman or midwife. There existed a few, very few, hospitals for maternity cases. They were usually called *lying-in hospitals* and were founded in the eighteenth century. For the most part they catered for the abnormal case, but it must be remembered that until comparatively recent years communication and transport were inordinately slow and unreliable and therefore these few institutions could only possibly serve the needs of a minute, and local, fraction of the population. The same factors provided, for exactly similar reasons, a severe limit in the availability of the expert obstetrician. Such men existed and have existed ever since Soranus of Ephesus, who practising and writing in the second century is with some justification honoured with the title "The First Obstetrician", but they were to be found only in the larger cities.

The extent, therefore, of domiciliary midwifery was such that every doctor had perforce to possess some knowledge of the art and indeed many practitioners became, usually by the hard route of bitter experience, extremely able obstetricians.

The midwife also was largely self-taught; much of her learning was handed down from mother to daughter, little or none came from books for the very obvious reasons that the books were few and almost certainly the midwives could not read. The practice of the midwife was further influenced by tradition, religion, superstition, mystery and the like. Descriptive accounts of these women, and of their medical colleagues, are both amusing and illuminating. They tell us something of the conditions under which our ancestors were born into this world. Let us relax for a few moments and read about Mrs. Elizabeth Nihell who was a midwife of the old school and who obviously did not like doctors. In 1760 she published a *Treatise on the Art of Midwifery*. In it doctors are called "he-practicers" and are referred to as "those self-constituted men-midwives made out of broken barbers, tailors or even pork-butchers, for I know one myself of this last trade, who after passing half his life stuffing sausages is turned an intrepid physician and man-midwife. See the whole pack open in full cry. To arms! To arms! is the word and what are those arms by which they maintain themselves but those instruments (the obstetric forceps) those weapons of death!" The first part of *Tristram Shandy* is full of it all and you

may remember there was a prolonged argument between Mrs. Shandy, whose baby was to be born in the country and who was all for a midwife, and her husband who desired the attention of a doctor described as “a scientific operator within so near a call as eight miles of us and who moreover had expressly wrote a five shilling book upon the subject of midwifery”. In the end Dr. Slop arrives and gives a demonstration of the forceps on Uncle Toby’s fist, somewhat to its detriment. “Upon my honour Sir, you have tore every bit of skin quite off the back of both my hands with your forceps and you have crushed all my knuckles into the bargain with them to a jelly.” Subsequently the midwife was able to report Tristram’s birth thus: “In bringing him into the world with his vile instruments he has crushed his nose flat as a pancake to his face, and he is making a false bridge with a piece of cotton and a thin piece of whalebone out of Susannah’s stays to raise it up.”

Such was the state of affairs in the world of midwifery certainly up to the end of the eighteenth century and for practical purposes until roughly fifty years ago. It is often said that it is a British characteristic to proceed by slow evolution and to build up our institutions and services by trial and error. The progress of the Maternity Services can best be described in chronological order as follows:

- 1726. The first Chair of Midwifery founded in Scotland for the *training of Midwives*.
- 1807. The Obstetric Society of London granted a diploma *to midwives*.
- 1881. The Midwives Institute was founded to raise the efficiency and improve the status of *midwives*. Sixty years later it became the College of Midwives and subsequently was granted a Royal Charter.
- 1886. For the first time Obstetrics was made compulsory in the training of doctors. This was largely due to a prolonged and energetic campaign conducted by the Worshipful Society of Apothecaries of the City of London.
- 1902. The Midwives Act was passed and the Central Midwives Board created. This was a great step forward and secured the certification of midwives in England and Wales.
- 1918. The Maternity and Child Welfare Act empowered Local Authorities to provide Antenatal Clinics. Such a service had been started earlier in several teaching hospitals and the value of antenatal care was rapidly assessed by the Local Authorities.
- 1929. Foundation of College of Obstetricians and Gynæcologists. Later granted a Royal Charter.
- 1948. Foundation of the National Health Service.

At this time by a process of “evolution” a woman in her pregnancy might find herself in the care of at least five separate people or authorities:

1. Her own doctor who might not practise obstetrics.
2. Another general practitioner who did practise obstetrics.
3. Her midwife.
4. Her antenatal care might be the responsibility of the Local Health Authority Clinic.
5. She was often referred to a Hospital Clinic for an "expert opinion".

Most women were the part responsibility in their confinement of three people and all of two. This state of affairs might not matter, indeed it could have been to her benefit, if the various services worked together as one co-ordinate unit. It was hoped that the institution of the National Health Service might have brought this about, especially as it had been so strongly advised by the Royal College of Obstetricians and Gynæcologists in 1947. But no—nothing happened and indeed nothing has happened, so that the reader of this chapter is likely to start his obstetric work as a member of one of the bodies mentioned above. The co-operation between the various parts of the Maternity Service will be found to be most variable and in many areas there seems to exist between these components what can only be described as an unhealthy rivalry. Individually each branch has done and is doing magnificent work, the value and results of which are demonstrable in the steady improvement in the figures published annually by the Ministry of Health of the maternal and perinatal mortality rates. Collectively, and with a minimum of direction, how very much more could be achieved.

History could teach us many other aspects of obstetrics, such as the fascinating story of the discovery by Chamberlen in England of the obstetric forceps, or of the use of anaesthetics in childbirth, or of the design of destructive instruments to assist in the delivery of the child, or of the introduction of and changes in antenatal care, but space does not allow more than their mention. The student can look forward to such reading later when it will help him to balance his knowledge and to instil into him a healthy sense of humility. In the meantime "to our muttons" and turn to Chapter II.

CHAPTER II

OVULATION, MENSTRUATION, FERTILIZATION AND EMBEDDING OF THE OVUM

IN health, throughout the years between puberty and the menopause, the lining of the body of the uterus is shed and discharged together with some blood through the cervix and vagina at fairly regular intervals of about one month. This external menstrual discharge is the outward sign of the activity of the reproductive hormones, which cause the release of an ovum from the ovary in each cycle, and control the cyclical changes which occur in the uterus, the lower genital tract and the breasts. The cycle is commonly of 28 days, but few women are precisely regular, and cycles of between 21 and 35 days may be accepted as being within normal limits. It is customary to describe these changes by counting from the first day of menstruation.

In normal cycles ovulation occurs about midway between menstrual periods, but there is considerable variation in this. Ovulation, which refers to the release of the ovum from the surface of the ovary into the peritoneal cavity, is preceded by the growth of the ovarian follicle (Graafian follicle), as will be described in more detail in the next section. After ovulation the follicle from which the ovum has been extruded becomes the corpus luteum. These cyclical changes in the ovary are brought about by the action of hormones secreted by the anterior lobe of the pituitary gland. These pituitary gonadotrophic hormones cause ripening of the Graafian follicle and ovulation, and also the subsequent formation and maintenance of the corpus luteum. The cells of the follicle and of the corpus luteum secrete oestrogen and progesterone, and these hormones in their turn bring about the cyclical changes in the endometrium.

Under the influence of these ovarian hormones the endometrium reaches its maximal development in the late part of the menstrual cycle, so that if the ovum liberated at mid-cycle is fertilized and carried down the Fallopian tube it will reach the cavity of the uterus when the endometrium is thick and hyperæmic, forming a prepared bed into which the fertilized ovum (zygote) can burrow and continue its development.

If the ovum in a particular cycle is not fertilized the activity of the corpus luteum ceases after a few days, so that the production of

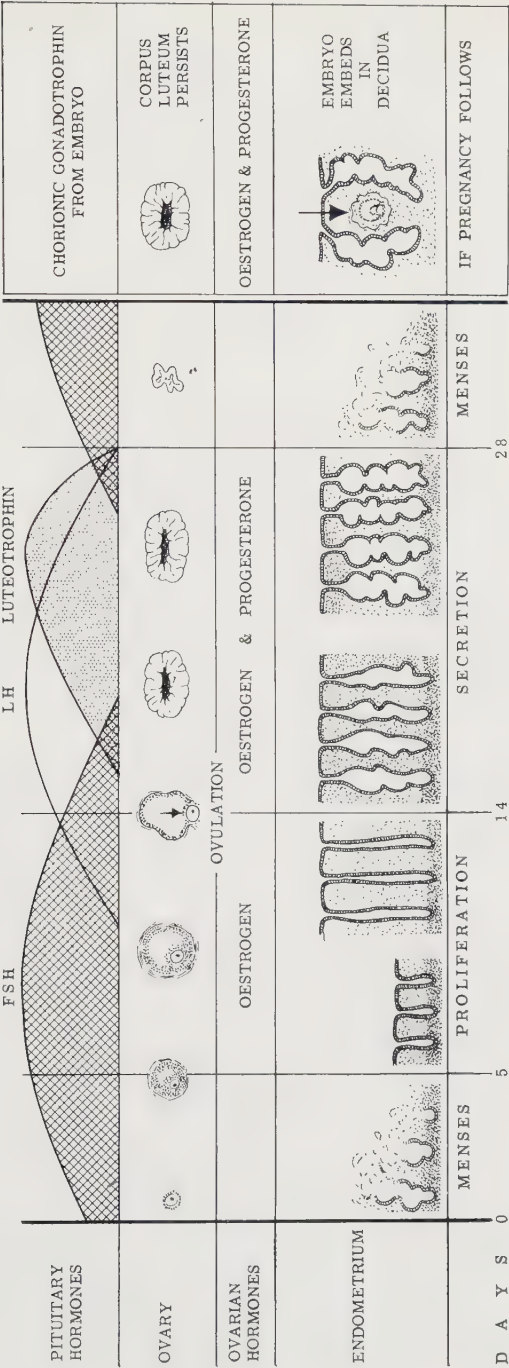


FIG. 1.

œstrogen and progesterone stops, and then the endometrium except for its basal layer breaks down and is discharged in the menstrual lochia. On the other hand, if the ovum is fertilized some of its chorionic cells produce another gonadotrophic hormone (chorionic gonadotrophin) which maintains the activity of the corpus luteum for a time. In addition the chorionic cells themselves produce œstrogen and progesterone in steadily increasing amounts. Thus, during pregnancy, œstrogen and progesterone, coming either from the ovary or from the chorionic cells of the zygote, maintain and carry on the growth of the endometrium, which is now described as the decidua of pregnancy, and the amenorrhœa of pregnancy follows instead of the menstrual periods.

OVULATION

In the human embryo, at as early as the 4th week of life, part of the cœlomic epithelium becomes thickened, and the cells in it proliferate and bud down into the underlying mesenchyme. This area was originally described as the germinal epithelium because it was thought that the primitive germ cells were derived from it. It is now known that germ cells migrate by amoeboid activity into this area from the wall of the yolk sac, and these invading cells form the primordial germ cells, some of which proliferate to give rise to numerous primary oöcytes. The oöcyte is a large round cell, with a relatively large nucleus that is rich in chromatin. The primary oöcytes become surrounded by a single layer of smaller flattened cells which are derived from the germinal epithelium. Each such system, consisting of an oöcyte and the surrounding flattened cells, is described as a primordial (Graafian) follicle, and at birth the human ovary contains more than 100,000 follicles. It is not certain if any of these primordial ova survive

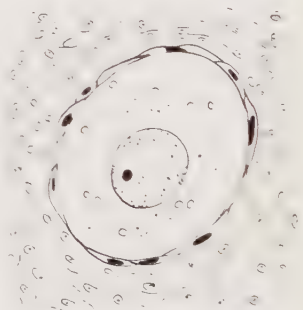


FIG. 2. —PRIMORDIAL FOLLICLE.

to mature after puberty. At one time it was held that all functioning ova were derived from this large store of primordial ova, and that no other ova developed after foetal life, but it is now thought to be more likely that the ova which mature after puberty are of more recent development from the germinal epithelium. It is certain that human ovarian germinal epithelial cells will form ova on tissue culture. Whatever the origin of the functioning ova may prove to be, throughout the reproductive years some of the follicles ripen and ovulate.

In each menstrual cycle several follicles start to mature, but for some reason that is not understood one outstrips the others, and in most cycles only one follicle reaches full development, although some cases of multiple pregnancy are due to ripening and fertilization of more than one ovum in one cycle. During maturation of the follicle the flat cells that surround the primordial ovum multiply and become rounded and arranged in several layers. These cells are now called granulosa cells. Their growth is eccentric, so that the ovum comes to lie at one side of the mass of granulosa cells, and eventually a clear albuminous fluid appears among these cells, so that a follicle is formed with the ovum placed to one side of this. (See Fig. 3.) The clump of

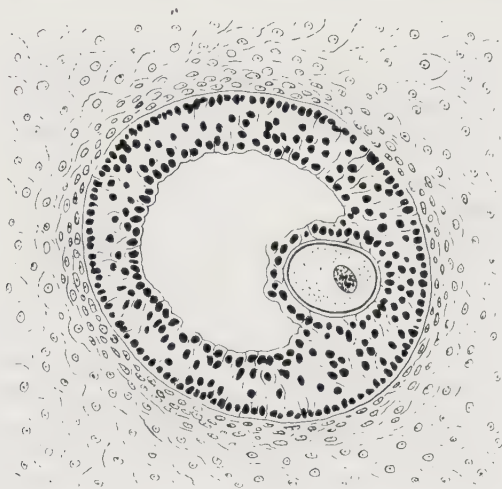


FIG. 3.—RIPENING FOLLICLE.

granulosa cells that are directly related to the ovum form a hillock (the discus proligerus) that projects into the cavity of the follicle, and at this stage the ovum is seen to be surrounded by a clear elastic membrane, the zona pellucida, within which it can rotate. The granulosa cells that are immediately related to the zona pellucida become arranged in a radial fashion, and are therefore described as the corona radiata. The ovum itself grows slowly during the maturation of the follicle, chiefly by increase in the volume of the cytoplasm, and reaches a diameter of about 0.13 mm.

The cells of the ovarian stroma which surround the granulosa cells also proliferate and become swollen by the accumulation of lipid. These cells form the theca interna, and play an important part in the formation of the corpus luteum at a later stage. The ovarian stroma cells outside the theca interna become somewhat compressed by the growth of the follicle, and form the theca externa. (See Fig. 3.)

As the Graafian follicle increases in size it approaches the surface of the ovary, where it is seen as a transparent vesicle which varies in size, but may reach a diameter of 10 mm. The follicle eventually projects from the surface of the ovary, through which it finally ruptures, and the gush of escaping follicular fluid carries the ovum, still surrounded by the cells of the corona radiata, into the peritoneal cavity.

The time of ovulation in women in relation to the menstrual cycle has been estimated from observations made on the ovaries at laparotomy, by direct recovery of ova from the Fallopian tubes at operation, and from indirect methods such as observations of changes in the basal body temperature. (See *Diseases of Women* by Ten Teachers). Although ovulation most commonly occurs between the 12th and 15th days of the cycle, there is considerable variation in healthy women, and it is far from rare for ovulation to take place as early as the 7th or as late as the 20th day. This fact is of importance in determining the duration of pregnancy. (See p. 57.) Ovulation has a closer time relation to the expected (following) period than to the preceding period; or in other words, there is more variation in the length of the part of the menstrual cycle that precedes ovulation than in the length of the part that follows it.

Ovulation is normally a spontaneous process controlled by the gonadotropic hormones of the pituitary gland, but it is possible that its timing may be altered by other influences. In some mammals ovulation is initiated by coitus, and it is possible that coitus, particularly when attended with a strong emotional reaction, may occasionally have this effect in women. This might explain the fact that at all stages of the cycle pregnancy sometimes appears to have followed a single coitus. The alternative explanation that either the ovum or sperm may survive for some time in the genital tract is less acceptable, and the available evidence suggests that unless the ovum is fertilized within 48 hours after ovulation it will not survive, and sperms do not appear to retain their activity for long.

CORPUS LUTEUM

After ovulation the walls of the Graafian follicle collapse and are thrown into folds, and there is usually a little hemorrhage into the empty cavity. The granulosa cells become swollen by the accumulation of yellow lipid, and are now termed granulosa-lutein cells, while similar changes occur in the cells of the theca interna and these are now termed theca-lutein cells. (See Fig. 4.) The central coagulum soon becomes organized by the invasion of capillaries. The mature corpus luteum is bright yellow in colour and is usually larger than the follicle from which

it developed, reaching a diameter of 1 to 3 cm. If the ovum that was discharged from the follicle is not fertilized then degenerative changes begin in the corpus luteum at about the 22nd day of the cycle. By the time that the menstrual period begins the luteal cells show fatty degeneration, and ultimately the cells lose their outlines and nuclei.

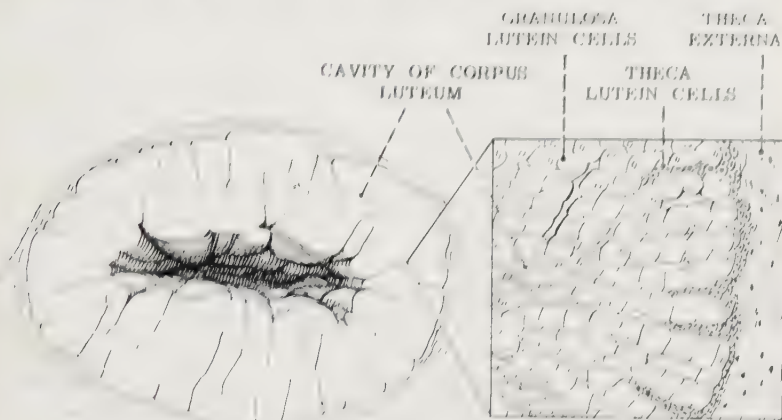


FIG. 4. CORPUS LUTEUM.

During subsequent weeks the whole structure becomes replaced by white connective tissue, and is then described as a corpus albicans. The corpus albicans is eventually absorbed, and finally the site of the follicle is only represented by a small scar.

On the other hand, if the ovum from the follicle is fertilized and pregnancy follows then the corpus luteum persists and enlarges further, maintaining its activity for about 12 weeks.

HORMONES CONTROLLING THE GROWTH AND ACTIVITY OF THE FOLLICLE AND CORPUS LUTEUM

Gonadotropic hormones from the anterior lobe of the pituitary gland control the ripening of the ovarian follicle, ovulation, and the formation and maintenance of the corpus luteum. Three separate actions have been recognized by animal experiments, but it is still uncertain whether these different effects are produced by three separate hormones, or by a single hormone acting under different conditions and in different concentrations. It is generally held that there are three separate substances.

Follicle stimulating hormone (FSH) converts a primordial follicle into a ripe Graafian follicle. For ovulation to take place small amounts

of a second hormone are required, and later in the cycle larger amounts of this second hormone are responsible for the formation of the corpus luteum. It is therefore known as *lutinizing hormone* (LH).¹ This hormone, LH, stimulates the maturing follicle, and later the corpus luteum, to secrete oestrogen, which in turn inhibits the production of FSH by the pituitary and stimulates the production of increasing amounts of LH. Thus ovulation is due to a balance between a rising concentration of LH and a falling concentration of FSH. As well as inhibiting the secretion of FSH and stimulating the production of LH, oestrogen stimulates the pituitary to produce a third hormone *luteotrophin*² after ovulation. Luteotrophin is responsible for the maintenance of the corpus luteum and causes it to secrete both oestrogen and progesterone. Progesterone inhibits the further production of LH.

If the ovum that is liberated in a particular cycle is fertilized its chorionic cells secrete another gonadotropic hormone known as *chorionic gonadotropin*. The chorionic cells also secrete oestrogen and progesterone. The chorionic gonadotropin is thought to be responsible for the prolongation of the activity of the corpus luteum during pregnancy.

MENSTRUATION ; THE ENDOMETRIAL CYCLE

In this account we are chiefly concerned with the endometrial changes that are preparatory to the reception of the fertilized ovum ; other details may be found in gynæcological textbooks. The number of days during which the menstrual flow persists varies in different women and from time to time in the same woman, but 4 to 5 days is the commonest time. The amount of blood lost varies between 50 and 150 ml. The period of time from the first day of one menstrual period to the first day of the next constitutes the menstrual cycle. We have already noted that the cycles are seldom precisely regular, and the duration of the cycle varies from woman to woman, but 28 days is the commonest cycle observed. The cycle consists of two phases, and it is customary to describe these by counting from the first day of the menstrual flow. The follicular (proliferative) phase starts on the first day of the cycle and lasts until the time of ovulation, when it is followed by the progestational (secretory) phase. (See Fig. 1.)

During the *follicular phase* the ovarian follicle is ripening, and its granulosa cells are secreting oestrogen. Soon after the end of the menstrual flow the endometrium is thin and consists of short straight tubular glands set in a scanty stroma. Under the influence of oestrogen

¹ This hormone is sometimes called Interstitial Cell Stimulating Hormone (I.C.S.H.).

² Luteotrophin is probably identical with prolactin.

the endometrium becomes more vascular, and the cells of the glandular epithelium and stroma both proliferate, so that the endometrium becomes thicker, with elongation of the straight gland tubules.

In the second *progestational phase* the cells of the corpus luteum secrete both oestrogen and progesterone, and these hormones acting together cause further growth of the endometrium with secretory changes that end with the onset of the next period. During this phase the gland cells become very tall and columnar, and pour out their secretion containing glycogen and mucin into the lumina of the glands. As a result of the epithelial hyperplasia and the accumulation

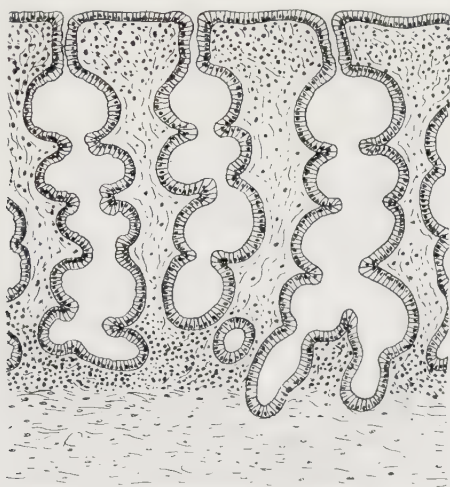


FIG. 5.—PREMENSTRUAL DECIDUA.

of secretion the glands become tortuous and convoluted, so that in a section they appear to have crenated and irregular margins. These changes do not affect the very deepest parts of the glands, nor the superficial parts adjacent to the uterine cavity, so that there is a great contrast between the basal layer of straight glands, the spongy intermediate layer of distended and convoluted glands, and the superficial compact layer with straight glands. The cells of the interglandular stroma become greatly swollen, chiefly by increase of cytoplasm. This alteration is greatest in the superficial layer of the endometrium, and accounts for the compact layer at the surface where the glands are compressed and straight, in contrast to the distended glands of the spongy layer. The arterioles are arranged spirally round the glands, and the whole endometrium becomes more vascular. All these changes are in preparation for the reception of the fertilized ovum. If the ovum is fertilized and embeds itself in the endometrium these changes

in the endometrium persist and are accentuated, and the greatly thickened endometrium is now called the decidua of pregnancy.

If pregnancy does not occur the menstrual flow begins on the 28th day, and is brought about by spasm of the coiled arterioles, which cuts off the blood-flow and causes ischæmic necrosis of the endometrium except for the basal layer. The endometrium shrinks and the arterioles buckle, and with relaxation of the vascular spasm the disintegrated endometrium is shed into the uterine cavity with some bleeding. At the end of the menstrual period regeneration of the endometrium takes place from the residual basal layer, and the next menstrual cycle begins.

MATURATION OF THE OVUM

The nuclei of human body cells each contain 46 chromosomes, and this number is maintained throughout successive divisions of the cells. The chromosomes are responsible for the transmission of various inheritable qualities. The reproductive cells, the ovum and the spermatozoon, differ from the ordinary body cells in that they each contain only 23 chromosomes. When fertilization occurs and the ovum and spermatozoon unite the total of 46 chromosomes is re-established, the male and female cell each contributing half of the total, so that some inherited qualities are derived from the father and some from the mother. The number of chromosomes in the germ cells is reduced during the maturation of the cells by special types of mitosis. In ordinary mitosis of body cells each chromosome divides into two, and the two halves of each chromosome separate and pass into the two daughter cells. In the reducing divisions of germ cells the chromosomes first become arranged in pairs, and then one member of each pair passes to each daughter cell, so halving the number of chromosomes in the mature germ cells.

In the case of the ovum the first maturation division occurs at the stage when the ovum is still in the ovary. The primary oöcyte divides into two cells of unequal size, a large secondary oöcyte and a small polar body. The polar body comes to lie in the perivitelline space within the zona pellucida. After this division the secondary oöcyte still contains the full number of chromosomes, but during the second maturation division, which takes place in the Fallopian tube, a second polar body is extruded, but in this division the number of chromosomes is reduced to 23, half of the chromosomes passing to the second polar body, and half remaining in the mature ovum. The polar bodies have no evident further function.

In the case of the spermatozoon a similar reducing division takes

place, but one chromosome, the sex chromosome, divides into two dissimilar parts termed X and Y. Mature sperms each bear either an X or a Y chromosome. In the division of the ovum the sex chromatin is equally divided, and all ova bear an X chromosome. During fertilization, if conjugation of an X sperm and an X ovum occurs, the final combination will be XX, and give rise to female genetic structure; but if conjugation of a Y sperm and an X ovum occurs the final combination will be XY, and give rise to male genetic structure. There are recognizable sexual differences in the nuclei of adult cells, particularly seen as a small club shaped projection of chromatin in the nuclei of polymorphonuclear leucocytes in the female.

TRANSIT AND FERTILIZATION OF THE OVUM

The mechanism by which the ovum reaches the lumen of the Fallopian tube has been much discussed. The ciliated cells of the fimbriæ at the abdominal ostium of the tube set up a flow of fluid which has been shown to be capable of carrying small particles from the recto-vaginal pouch into the tube. In addition, the injection of drops of radio-opaque fluid into the poles of the ovary at the time of laparotomy and subsequent hystero-salpingography have enabled the relative positions of the uterus, tubes and ovaries to be studied. It has been shown that the fimbriated end of the tube is brought into close contact with the ovary at the time of ovulation, although the mechanism of this is uncertain. Once the ovum has reached the cavity of the tube it is carried downwards by the ciliary action. The tubes show peristaltic movements, but the importance of these in moving the ovum down the tube is less certain. The time taken for the zygote to reach the uterine cavity after ovulation is probably about 5 days.

Fertilization of the ovum normally takes place in the Fallopian tube, although in very rare instances it may occur on the surface of the ovary as is demonstrated by the occurrence of ovarian pregnancy. The sperms reach the tube by their own active movements, passing upwards against the stream of fluid which is directed down the tube by the cilia. Spermatozoa can move at a speed of 3 mm. per minute. Numerous sperms may be found near the ovum in the tube, to which they are attracted by chemotaxis. Several may penetrate the zona pellucida, but as soon as one sperm makes its way into the ovarian cytoplasm the ovum separates from the zona and becomes impervious to further penetration.

The head of the spermatozoon represents the nucleus of the male cell, and it fuses with the nucleus of the ovum to form the segmentation nucleus, whose complement of 46 chromosomes is again complete.

EMBEDDING AND EARLY DEVELOPMENT OF THE ZYGOTE

After the formation of the segmentation nucleus the zygote starts to divide, and soon a solid clump of cells called the morula is formed. A cavity appears among the cells of the morula so that it becomes vesicular, and it is then termed the blastocyst. This stage of development is reached while the zygote is still in the Fallopian tube.

The outermost cells of the blastocyst form the trophoblast, whose function will be to bury the ovum in the uterine decidua and secure its implantation there. The trophoblast has the power of eroding and digesting the surface epithelium of the decidua, and the fertilized ovum sinks into the bed prepared for it, becoming embedded in the thickness of the decidua, lying in a cavity in the stroma between adjacent endometrial glands. The glands are distorted and pushed aside by the enlargement of the growing ovum. The aperture through which the ovum entered the decidua is sealed over with a plug of fibrin. Maternal blood vessels are invaded and eroded by the trophoblast, and extravasation of maternal blood occurs around the ovum.

The structure of the blastocyst is indicated in the diagrams. (See Fig. 6.) The formative cell mass, from which the embryo will develop, is seen projecting into the blastocyst, and two small cavities appear in the cells of the formative cell mass, from which the amniotic cavity and the yolk sac develop. The diagrams indicate the progressive extension of the amniotic cavity, which comes to surround and envelop the embryo, and ultimately the amniotic membrane covers the body stalk up to the point at which it becomes continuous with the embryonic ectoderm.

Very soon the trophoblast, while it is eroding into the maternal decidua, becomes arranged in projecting masses, at first in a labyrinthine formation, but later arranged as villi, which grow and branch. Maternal blood-vessels are opened by the cytolytic action of the trophoblast, so that maternal blood lies in the intervillous spaces, and the embryo starts to secure its nutrition from this. The trophoblast becomes differentiated into two layers. There is a thick outer layer of syncytio-trophoblast, in which the nuclei are scattered in a mass of cytoplasm that has no evident division into separate cells. The inner layer of cyto-trophoblast (Langhans' layer) is thinner, and consists of a single layer of rounded cells.

The blastocyst is lined with extra-embryonic mesoderm, and it will be seen from the diagrams (Fig. 6) that this is continuous with the mesoderm of the embryo itself. The extra-embryonic mesoderm is continuous with the central tissue of the villi, so that each villus has an

1 BLASTOCYST
Formation of amnion
and yolk sac in
formative cell mass.

2 EXTENSION OF AMNIOTIC
CAVITY
Early formation of chorionic villi.

Trophoblast
Mesoderm

CHORION

Syncytiophoblast
Cytotrophoblast
Mesoderm

EXTRAEMBRYONIC COELUM

YOLK SAC

AMNIOTIC CAVITY

3 CHORIONIC VILLI
AND BODY STALK.

CHORIONIC VILLUS
consisting of trophoblast
and mesodermal core

EMBRYONIC PLATE

4 FORMATION OF PLACENTA
AND MEMBRANES

YOLK SAC
in body stalk

AMNIOTIC
MEMBRANE

CHORION

CHORIO-DECIDUAL SPACE
containing maternal blood

VILLUS consisting of trophoblast
and mesodermal core

FOETAL BLOOD VESSELS
developed in chorionic mesoderm

HEART

FIG. 6.—DIAGRAMS TO SHOW THE FORMATION OF THE PLACENTA AND FOETAL MEMBRANES.

outer covering of trophoblast and a central mesodermal core. Lacunæ appear in the mesoderm and gradually become joined to form a pattern of primitive blood-vessels, extending through both the body of the



[By permission of Prof. W. J. Hamilton.]

FIG. 7.—SECTION OF HUMAN EMBRYO OF 10-11 DAYS DEVELOPMENT.

1. Uterine gland. 2. Maternal blood-vessel. 3. Syncytiotrophoblast. 4. Amniotic cavity. 5. Embryonic ectoderm. 6. Embryonic endoderm. 7. Primitive yolk sac (exocœlom). 8. Extra-embryonic mesoderm. 9. Operculum. 10. Cytotrophoblast. 11. Artificial space between the cytotrophoblast and the extra-embryonic mesoderm. 12. Lacuna of trophoblast.

embryo and the extra-embryonic mesoderm. By this arrangement the placental circulation is ultimately formed; the foetal heart not only pumps blood through the tissues of the foetus itself, but also through the tissues of the placenta.

The combined layer of trophoblast and underlying mesoderm is termed the chorion, and the villi are the chorionic villi. Within the chorion is the amniotic membrane that bounds the amniotic cavity.

DECIDUA

The formation of the decidua of pregnancy has already been described. During pregnancy further thickening and hyperæmia occurs, with enlargement and multiplication of the stromal cells, which form a mass of large closely packed polygonal cells, especially in the superficial stratum compactum. The endometrial glands run through this layer, elongated but otherwise unchanged in the superficial part of

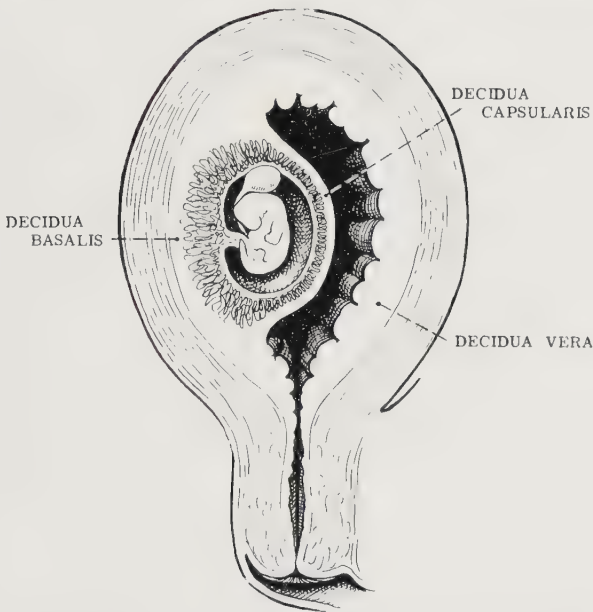


FIG. 8.—UTERUS CONTAINING AN EMBRYO OF ABOUT NINE WEEKS.

their course. Deeper down they are tortuous and distended with secretion. The decidua is thus differentiated into two layers, a superficial compact layer and a deeper spongy layer.

The ovum embeds in the stratum compactum and produces a slight projection into the uterine lumen, the most frequent site of implantation being the upper and posterior part of the uterine cavity. According to its relations to the embryo three parts of the decidua are distinguished.

Decidua Basalis. This is the portion of the decidua which lies between the embryo and the muscular wall of the uterus. It bounds

the deeper half of the implantation cavity, and later on forms the site of attachment of the discrete placenta, and a number of thin-walled sinuses pass through it, bringing blood to the intervillous spaces. It also serves as a barrier against the invasion of the muscle by the syncytio-trophoblast, and under normal conditions the chorionic tissue does not penetrate through the decidua into the muscle.

Decidua Capsularis. This is the portion of the decidua which intervenes between the embryo and the uterine cavity, and it bounds the superficial half of the implantation cavity. As the ovum grows it bulges out into the cavity, and by the 12th week the growing embryo fills the cavity, so that the decidua capsularis becomes fused with the decidua vera.

Decidua Vera. This is the portion of the decidua that is not related to the site of implantation, and lines the rest of the cavity of the uterus.

CHAPTER III

THE PLACENTA

THE previous chapter gave a general outline of the implantation and early development of the embryo, and we may now proceed to describe the growth and anatomy of the placenta in more detail.

In the most primitive type of placenta the foetal chorion is merely applied to the surface of the maternal decidua, so that exchange of nutrients and excretory products between maternal and foetal blood must take place through these layers (epithelio-chorial placenta). In the human placenta the trophoblast erodes into the decidua, so that the endothelium of the maternal blood-vessels is destroyed and maternal blood is in direct contact with the chorion, without the intervention of any decidual tissue (hæmochorial placenta).

At first the syncytio-trophoblast forms an open reticulated mesh-work, whose lacunæ are filled with maternal blood, and in part the trophoblast replaces the maternal endothelium. The thin syncytial partitions separating the distended spaces break down so that all round the periphery of the ovum there is a slowly moving maternal circulation. This cavitation, as it proceeds, separates that part of the trophoblast which is in contact with the maternal tissues, called the junctional zone, from that which forms the immediate boundary of the blastocyst, and which, when the embryonic mesoderm appears, will constitute the chorion.

About the 13th day the trophoblast, broken up by the lacunæ, presents syncytial trabeculæ, into which there occurs an extension of cyto-trophoblast which differentiates into cyto-trophoblastic cell columns. This is the gradual initiation of the villous stage, with the trabeculæ referred to as the *primary villi*, and the lacunar spaces lined by a thin sheet of syncytio-trophoblast and communicating freely with one another and containing maternal blood as the *intervillous space*. When the embryonic mesoderm appears, secondary cores of loose extra-embryonic mesoderm (mesenchyme) can be seen within these cyto-trophoblastic columns forming *secondary villi*. By the 15th or 16th day *tertiary or definite villi* result from the vascularization of these secondary villi by the formation of an arterio-capillary-venous system in the mesenchymal core of each villus. The columns of cytotrophoblast pierce the trophoblastic shell at many points and come into direct contact with the decidua, thus anchoring the main villi to the

maternal tissues at the junctional zone. Here can be seen, lying between the invading trophoblast and decidua, a wavy layer of fibrin—the layer of Nitabuch. The number of these primary or anchoring villi is small, but by budding from them and from the chorion, true chorionic villi are formed, which differ from the former in that their outer ends apparently protrude free into the intervillous space. The capillaries in the terminal parts of the villi are much convoluted, with an arrangement reminiscent of that in a renal glomerulus, but adjacent villi are not joined, *i.e.* the villi do not form a reticulum.

Structure of a Chorionic Villus.—This consists of a core of mesoderm, or stroma, and an epithelial covering.

The stroma at a very early stage consists of anastomosing small stellate cells enclosing clear lymph spaces, but from the middle of pregnancy there is a definite connective tissue appearance. Embedded

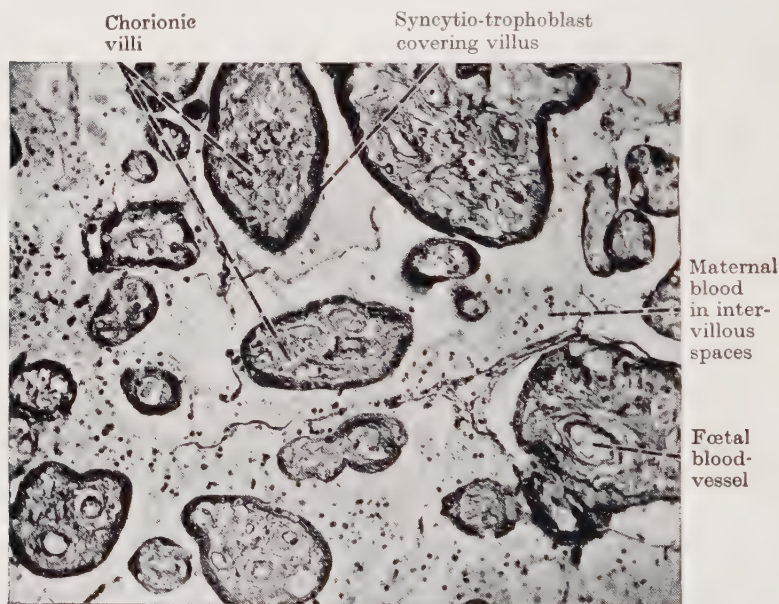


FIG. 9.—VERTICAL SECTION THROUGH HUMAN PLACENTA AT TERM. MAGN. 170×
(SMOUT & JACOBY: *Gynaecological and Obstetrical Anatomy*.)

in the stroma are numerous blood-vessels. In the main villous stems the arteries and veins have connective tissue walls, but in the terminal villi only capillaries are present. The arteries are branches of the umbilical arteries and in the terminal villi end as capillaries from which purified blood is collected into venous radicals to pass back into

the veins of the main villous stems, and thence *via* the veins of the chorionic plate to the umbilical vein of the cord.

From the time of their formation in the 3rd week until the end of the 12th week, the epithelial covering consists of a single inner layer of cyto-trophoblast (Langhans' cells) in immediate contact with the stroma, and an outer layer of a multi-nucleated mass of protoplasm (syncytio-trophoblast) in immediate contact with the blood in the intervillous space. After the 20th week the cytotrophoblast begins to disappear until finally only a thin layer of syncytium remains. This condition persists until term.



FIG. 10.—DIAGRAM TO SHOW THE STRUCTURE OF THE PLACENTA.

Further Development of the Placenta.—The chorionic villi are formed in immense number, and constitute the vast bulk of the villous system which covers the placental area. Thus comes about an arrangement whereby over a great surface, thin walled vessels carrying foetal blood are merely separated from the maternal blood by the meagre connective tissue of the villi and a thin layer of trophoblast.

At first villi are formed all over the surface of the gestation sac, so that an ovum of 4 weeks' growth appears as a translucent thin walled sac, covered by a spherical halo of soft villi like floss silk (Fig. 11). As growth proceeds, the decidua capsularis becomes thinner and between the 12th and 16th weeks, the villi on the capsular surface of the ovum rapidly degenerate, leaving this side of the chorion smooth (chorion laeve). In compensation, those on the surface opposed to the decidua basalis hypertrophy greatly (chorion frondosum) and become matted into a solid disc which is the fully developed discrete placenta.

The naked eye appearance has not the least resemblance to the aureole of free villi which covers the ovum at 4 weeks, but the microscope at once reveals the identity of one with the other.

The discrete placenta is formed by the 12th week, though proportionately it then comprises a much larger part of the ovular surface than it does at term.

Increase in Size of the Placenta.—During the 4th and 5th months, irregular sheets of trophoblastic tissue project from the maternal side of the intervillous maternal blood-space, so dividing this space into sinuses. How these trophoblastic septa are formed is not certain, but it is to be noted that they do not reach the foetal side of the intervillous space. From the end of the 4th week, when the villi have penetrated towards the decidua basalis, there is no further invasion.



FIG. 11.—THE CHORIONIC VILLI.

(SMOUT & JACOBY: *Gynaecological and Obstetrical Anatomy*.)

Further growth in thickness of the placenta is now due to growth of the chorionic villi with an accompanying expansion of the intervillous sinuses. These sinuses are entirely within the foetal tissue, and only in the pathological placenta accreta is the trophoblast found penetrating the thin basal decidua. Until the end of the 16th week, the placenta grows both in thickness and circumference. Subsequently there is no increase in thickness, but the placenta continues to increase in size circumferentially until near term. The growth is proportionate

with that of the foetus and of that part of the wall of the uterus to which the placenta is attached.

The Placenta at Term.—The placenta at term is circular in shape, forming a spongy disc 20 cm. (8 inches) in diameter, and about 2.5 cm. (1 inch) thick near the insertion of the umbilical cord when this is centrally placed. It thins off towards its edge, which is abrupt. Its weight is about 500 g. ($1\frac{1}{4}$ pounds), but there is some variation according to the size of the child.

It has a foetal and a maternal surface. The foetal surface is covered by smooth amnion underneath which the chorion is closely applied. The blood-vessels are visible beneath it as they radiate from the insertion of the umbilical cord. The maternal surface is rough and spongy, and presents a number of polygonal areas known as cotyledons, each being somewhat convex, and separated from those adjoining it by a shallow groove. Each cotyledon is formed by, and corresponds to a main villous stem and its system of branch villi. The number of cotyledons, between 15 and 20, depends on the number of end arteries into which the umbilical artery divides, and this is determined by the number of the anchoring villi. The colour is a dull red, with a thin greyish, somewhat shaggy layer on the surface which is the remnant of that part of the decidua basalis which has come away with the placenta. Numerous small greyish spots are frequently seen on the maternal surface. They are due to the deposit of calcium in degenerate areas and are the result of normal senescence. They are more numerous in placenta at term. These deposits do not occur in the villi nor interfere with the maternal circulation in the intervillous spaces, and are of no importance.

The chorion spreads away from the edge of the placenta to form the outer layer of the two membranes which enclose the foetus and liquor amnii. Though the line of demarcation between the placental edge and the chorion is sharp, yet they are essentially one structure, for the placenta is a specialized part of the chorion.

The umbilical cord usually reaches the foetal surface of the placenta about the middle of its disc, though sometimes at its edge (battle-dore placenta), and brings with it two umbilical arteries and one umbilical vein. The arteries having reached the placenta, distribute themselves in two main ways: (a) when the arteries, dividing dichotomously, at once spread themselves over the surface (Fig. 12); and (b) when they extend almost to its margin before they break up and their calibres diminish (Fig. 13).

The area supplied by each artery differs, being sometimes equal, and sometimes unequal. Whichever method of distribution obtains,

there is always a communication between the two arterial systems shortly after the arteries have reached the placenta in order to equalize



FIG. 12.—DISPERSE TYPE OF PLACENTA (SMOUT).

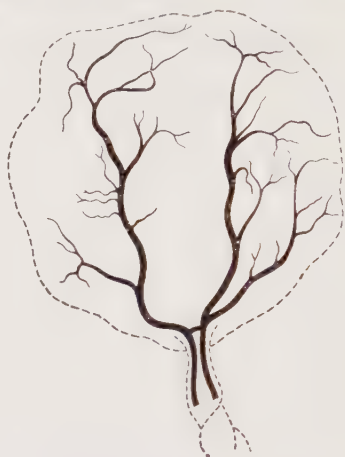


FIG. 13.—MAGISTRAL TYPE OF PLACENTA (SMOUT).



FIG. 14.—INJECTION OF CAPILLARIES IN THE PLACENTA (SMOUT).

the pressure in the two systems. Except for this communication, the main trunks into which the arteries divide are terminal, and each ends

in a tuft of capillary vessels (Fig. 14). These tufts correspond to the cotyledons in which they are in free communication with the venules, which make up the corresponding tributaries of the umbilical vein.

The substance of the placenta is made up almost entirely of a multitude of chorionic villi, most of which protrude in an arborescent manner into the intervillous blood-spaces. The placenta might be described as a space containing maternal blood, which is bounded on the maternal side by a decidual plate, and on the foetal side by a chorionic plate from which the chorionic villi branch into the maternal blood. Spanner believed that the foetal vessels ran in septa from the chorionic plate to the decidua, and then turned back again towards the chorion before giving off the fine branches to the villi, but this view is no longer accepted and the simpler plan shown in Fig. 14 is probably correct.

The intervillous space can be regarded as a lake of maternal blood which has left the maternal vessels slowly to flow round in a space bounded by foetal trophoblast. To supply this space arteries and large sinuses perforate the decidual plate. Some observers have maintained that the blood flows to the edge of the placenta to be collected in a "marginal sinus" before leaving the intervillous space, but this is not generally accepted, and vessels serving the arterial inflow and venous drainage appear to be scattered indiscriminately over the entire decidual plate. There are no nerves in the placenta.

FUNCTIONS OF THE PLACENTA

The placenta has the following functions :

1. It enables the foetus to take oxygen and nutrients from the maternal blood.
2. It serves as the excretory organ of the foetus ; carbon dioxide and other waste products pass from the foetal to the maternal blood.
3. It forms a barrier against the transfer of infection to the foetus, although a few organisms, such as the virus of rubella and the spirochæte of syphilis are able to pass.
4. The placenta secretes chorionic gonadotropin, oestrogen and progesterone in large amounts, and possibly other hormones, and these hormones play an essential part in the maintenance of the decidua and the growth of the uterus and breasts.

In general the trophoblast and underlying endothelium of the foetal vessels behave as a semi-permeable membrane, allowing the free passage of water and soluble substances of relatively low molecular weight according to the laws of osmotic equilibrium, but preventing the passage of substances of high molecular weight and of particles

such as red blood-corpuscles or bacteria. In a microscopical section it can be seen that the nucleated red cells in the foetal capillaries of the villi are completely separated from the maternal red cells in the intervillous space. Nevertheless, perhaps because of occasional breaking off of the delicate fronds of the chorionic villi, a few foetal red cells and fragments of villi may occasionally enter the maternal circulation. This entry of a few red cells in cases in which the blood groups of the foetus and mother are different explain the production of maternal antibodies against foetal red cells, which is observed in cases of hæmolytic disease.

Substances with a molecular weight of less than 1000 are, in general, able to pass the placental barrier, and it is to be noted that most anæsthetic agents and drugs fall into this class. The concentrations of water, sodium, chloride, magnesium, urea and uric acid are equal in maternal and foetal blood. However, it has been found that a few substances are in higher concentration in foetal than in maternal blood, including amino-acids, nucleic acid, calcium and inorganic phosphorus, and it is therefore suggested that the trophoblast has some power of selective transfer of these, most of which, it will be noted, are substances necessary for the building of foetal tissues. Glucose is found in higher concentration in maternal than in foetal blood, not because it does not pass the placenta freely, but probably because of its continual utilization by the foetus. Iron passes in solution from the maternal plasma to the foetus.

The mechanism of transfer of fats and lipoids such as cholesterol to the foetus is uncertain. It is known that most of the fat in foetal tissues is synthesized from carbohydrate, and it was once believed that the placenta was absolutely impermeable to lipid substances, but recent investigations suggest that some of these substances may pass unchanged, so that it may turn out that foetal fat has a dual origin, chiefly from synthesis from carbohydrate, but with a minor addition by direct transfer of maternal lipoids.

Although most substances of high molecular weight do not pass the placental barrier, there are unexplained exceptions, such as the transfer of antibodies from the mother to the foetus.

As regards hormones, it is known that oestrogens, androgens and thyroxine pass the placenta, whereas probably insulin, parathyroid hormone, and posterior pituitary hormones do not. The vagina of the newborn child shows evidence of the oestrogenic action of maternal hormones *in utero*.

Placental permeability increases as pregnancy progresses, probably because the trophoblast becomes thinner as pregnancy proceeds, and also because the villi become finer and more branched. The transfer of oxygen to the foetus is discussed below.

Placental Hormones.—The placenta is an organ of internal secretion, and secretes oestrogens, progesterone, chorionic gonadotrophin and also perhaps a hormone resembling adrenocorticotrophin. During pregnancy there is a progressive increase in the blood-oestrogen and the urinary oestrogen concentration which reaches a peak just before the onset of labour. The disappearance of oestrogens from the blood and urine after the birth of the placenta almost certainly indicates the placenta as the source, although the placenta may, in addition, be a store-house for oestrogens produced elsewhere. Until the end of the 8th week the corpus luteum continues to secrete progesterone. With the gradual failure of this structure the placenta becomes responsible for the secretion of progesterone which, like that of oestrogen, reaches a peak just before labour. The excretion of progesterone in the urine in the form of pregnandiol is about 10 mg. per diem in the 8th week and reaches a level of about 80 mg. by the end of pregnancy. As in the case of oestrogen, progesterone may be formed in the adrenal cortex and stored in the placenta. Chorionic gonadotrophin appears in the urine as early as 8 days after the first missed period. It reaches its peak concentration at 50 to 60 days, then falls rapidly to a low level at which it remains steady, and finally disappears at a very variable rate a few days before the onset of labour. Chorionic gonadotrophin disappears from the urine if the foetus dies and persists after labour if placental tissue is retained. The presence of this hormone in the urine forms the basis of the various tests for pregnancy, being produced in the cytotrophoblast. Placental steroids are produced in the syncytium.

THE CHORIONIC MEMBRANE

After the discrete placenta is formed, the rest of the chorion atrophies and persists only as a thin, friable membrane intervening between the amnion and the decidua. On its outer surface, vestiges of decidual cells and of the trophoblastic layer with which it was formerly covered can be distinguished microscopically, but the bulk of it is a fragile connective tissue, which is loosely attached to the amnion.

Sometimes vessels from the umbilical cord can be seen running across it, and occasionally the cord itself is attached to the chorion outside the placental margin, so that the umbilical arteries and veins run across it to reach the placenta (velamentous insertion). Very rarely the whole surface remains placental up to an advanced stage of pregnancy, a maintenance of the early condition (placenta diffusa, p. 33).

THE AMNION

The first appearance of the amnion is a hollow space in the embryonic ectoderm. It is lined by cubical cells, which quickly become more columnar at the part which eventually forms the embryonic plate and the embryo. At first more or less spherical, the amniotic cavity soon becomes flattened down upon the embryo and closely applied to it. As the head and tail appear and the body-walls fold round to enclose the embryonic coelom, the amnion attached at their margins is carried round also, so that the embryo is, as it were, pushed up and projects into the amniotic cavity. When the body cavity of the embryo is quite closed up, the amnion is attached all round the place at which the ventral stalk emerges. (See Fig. 6.)

At this period the embryo is relatively very small, and has the amnion closely applied to it, while the cavity of the blastocyst is relatively very large. Now a great change begins to occur. The amniotic cavity enlarges out of proportion to the embryo, and becomes distended with fluid, and the embryo is gradually carried more and more into the amniotic cavity by elongation of the ventral stalk, which becomes the umbilical cord.

The enlargement of the amniotic cavity which brings about the complete investment of the umbilical cord likewise brings the amnion into close contact with the foetal surface of the placenta. This surface is, therefore, completely covered by the amnion. The amnion is attached to the placenta and chorion in a loose manner, and can be separated up to the insertion of the cord.

The amnion is lined by a single layer of cubical or flattened epithelial cells which is attached to a layer of connective tissue. The epithelium contains granules, fat droplets and vacuoles. The connective tissue upon the outer side of the amniotic membrane is closely applied to the similar connective tissue upon the inner side of the chorion; the two merely stick together, but are not organically united. They can easily be separated from one another at all periods of pregnancy. That portion of the amnion which covers the umbilical cord, however, is very closely incorporated with the connective tissue of the cord and cannot be stripped off.

The Amniotic Fluid.—The amniotic fluid is usually slightly turbid from the admixture of solid particles derived from the foetal skin and the amniotic epithelium. It may also be stained a greenish colour if any meconium has been passed into it.

The composition of the fluid at full time is as follows: it has a specific gravity of about 1010. It contains inorganic salts, chiefly

alkaline chlorides, phosphates and sulphates, and albumin. Urea is present from the 5th week onwards in increasing amounts up to full time. The solid matter is composed of lanugo, hairs, epithelial cells and sebaceous material from the foetal skin, and cast-off amniotic epithelial cells.

The amount of amniotic fluid at term averages 600 ml. (20 ounces), but the volume varies widely, perhaps from 300 to 1500 ml. in normal cases. The amount of the fluid relative to the size of the foetus is much greater in the early months of pregnancy, when the foetus floats freely in it.

The origin of the liquor amnii is still uncertain. Although the foetus passes small quantities of urine into the amniotic fluid in late pregnancy the contribution from this source is very small. Nearly all the fluid must somehow pass into the cavity through the amniotic membrane, and the question whether the fluid is a secretion or a simple transudate is still unsettled. Vacuoles have been observed in the cells of the amniotic epithelium, but it is by no means certain that these indicate secretory activity.

Recent investigations using radio-active isotopes have given surprising results. In each hour about 500 ml. of water, 13 mEq. of sodium and 0.6 mEq. of potassium are exchanged between the amniotic fluid and the maternal plasma. This means that about half the fluid in the amnion is exchanged every hour. The question whether this exchange takes place directly between maternal plasma and amniotic fluid, or indirectly through the foetal plasma, appears to have been settled by recent investigations which showed that there was a constant exchange of about 3000 ml. per hour between maternal and foetal plasma, and an exchange of about 400 ml. per hour between foetal plasma and amniotic fluid, but no direct exchange between maternal plasma and the fluid.

The presence of lanugo, hairs and epithelial scales in meconium shows that the fluid is certainly swallowed by the foetus, and some of it passes from the gut, or possibly the lungs, into the foetal plasma.

The Uses of the Liquor Amnii.—The liquor amnii provides a protective medium for the foetus, guarding it against shocks and jars, equalizing the pressure exerted by uterine contractions, and allowing it, at least in the early months, plenty of room for free movement. There can be no doubt that some of it is swallowed, but it can hardly be regarded as a source of nutriment for the foetus, because the content of albumin and salts is so small although it will supply some water to the foetus. During labour the liquor amnii forms a fluid wedge which, under the influence of the uterine contractions,

operates upon the internal os uteri and canal of the cervix. When the membranes rupture at the end of the first stage of labour, it flushes the birth canal from above downwards with a fluid which is aseptic and bactericidal.

THE UMBILICAL CORD

The umbilical cord, or funis, forms the connexion between the foetus and the placenta. It is derived from the ventral stalk and receives a close covering of amniotic epithelium. The constituents of the umbilical cord are as follows :—

1. The covering epithelium is a single layer of amnion. 2. Wharton's jelly, which is composed of cells with elongated anastomosing processes in a gelatinous fluid, and represents the extra-embryonic mesoderm (see p. 17). 3. Blood-vessels. These are at first four in number, two arteries and two veins. The embryonic umbilical veins fuse before the 3rd month leaving a single vessel. The two umbilical (hypogastric) arteries are derived from the internal iliac (hypogastric) arteries of the foetus, and carry the venous blood from the foetus to the placenta. The umbilical vein carries the oxygenated blood from the placenta to the foetus. 4. The umbilical vesicle and its vitelline duct, the shrivelled remnant of the yolk-sac, may be found as a very small yellow body near the attachment of the cord to the placenta. 5. The allantois, which occasionally occurs as a blindly-ending tube just reaching into the cord, is continuous inside the foetus with the urachus and bladder.

The cord is commonly about 50 cm. (20 inches) in length, but its length varies greatly, and may be as long as 180 cm. (6 feet), or as short as 7.5 cm. (3 inches). It is usually as thick as the little finger, but is not uniform since, as a rule, it presents nodes and swellings which are sometimes caused by dilatation of the umbilical vein, but more often by simple local increase in Wharton's jelly. At the earliest stage the cord is straight and somewhat flattened, but as early as the 12th week it shows a spiral twist. In addition to the nodes above mentioned, sometimes called false knots, the cord, on rare occasions, contains one or more true knots, due to the foetus passing through a loop in the cord. If such a true knot becomes drawn very tight the child will perish from obstruction to its circulation. The cord is often coiled round the child's body or neck, but seldom gives rise to any serious trouble thereby. Further reference will be made to anomalies of the cord in the next chapter.

CHAPTER IV

ANOMALIES AND DISEASES OF THE PLACENTA AND CORD

Anomalies in Size.—At term the average diameter of the placenta is about 20 cm. (8 inches) and the thickness varies from 2 to 3 cm. ($\frac{3}{4}$ to $1\frac{1}{4}$ inches), being greatest near the centre. Some of the largest placentæ are found in uniovular twin pregnancies.

Anomalies in Weight.—The average weight of the placenta at term is 500 g. ($1\frac{1}{4}$ pounds). The weight varies slightly according to whether the umbilical cord has been ligatured late or early, thus imprisoning little or much of the foetal blood. On an average the weight is about one-sixth of that of a healthy child. An increase in weight may occur in syphilis, when the placental weight may be as much as a quarter or even half that of the foetus. An increase has also been found in cases of diabetes and in hæmolytic disease of the foetus (*hydrops foetalis*).

Site of Implantation of the Placenta.—The placenta is usually found to be attached to the uterine wall near the fundus, and on either the anterior or posterior surface. If the placenta is on the anterior wall it may play a part in causing an occipito-posterior position of the foetus, as the foetal back cannot easily be accommodated in the normal anterior position.

In about 1 in 250 pregnancies the placenta is implanted in part or in whole on the lower segment of the uterus (*placenta prævia*). This is a serious abnormality as it may cause severe hæmorrhage in pregnancy or labour. (See p. 463.)

Abnormalities in Shape of the Placenta.—The chorionic villi originally covered the whole surface of the chorion, and a discrete placenta is only formed after the 12th week of pregnancy, when most of the villi atrophy, but those related to the basal part of the decidua, which have the richest blood-supply, hypertrophy and continue to proliferate. Various placental anomalies occur, which are thought to be due to some abnormality of vascularization at an early stage :

Placenta Diffusa is a very rare abnormality in which chorionic villi persist and remain functional all round the embryo. Although it does

not interfere with the nutrition of the foetus it may be the cause of hæmorrhage during pregnancy, and the placenta may fail to separate normally in the third stage of labour.

Bipartite and Tripartite Placenta.—Instead of a single disc the placenta may consist of two or three lobes, usually partly fused, but sometimes completely separate except for their vascular attachments. Such abnormalities are of no significance.

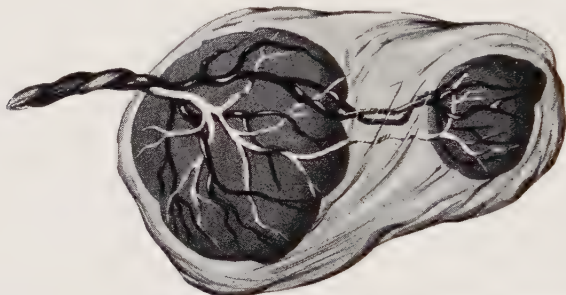


FIG. 15. — PLACENTA SUCCENTURIATA, SHOWING VESSELS RUNNING IN THE CHORION FROM THE MARGIN OF THE MAIN PLACENTA TO THE ACCESSORY PORTION.

Placenta Succenturiata.—This anomaly is not uncommon. One or more accessory lobules of placental substance are found on the chorion at a distance from the edge of the main placenta. They are united to the placenta by vascular connexions, both arterial and venous. The placenta succenturiata is of clinical importance because it is liable to be retained in the uterus after the placenta proper has been expelled. Postpartum hæmorrhage may follow, because the retained lobe interferes with the retraction of the uterus, and if organisms invade the retained tissue it may be a source of infection of the uterine wall.

This abnormality should be discovered when the membranes and placenta are inspected after delivery, when a round defect will be seen in the membranes, and a leash of vessels will be seen running from the edge of the placenta to end abruptly where they have been torn across at the edge of the defect. In such a case the uterine cavity should immediately be explored, and the succenturiate lobe removed.

Placenta Membranacea.—Sometimes the placenta is oval or ring shaped with a central defect which is occupied only by the membranes. This is of no significance.

Placenta Circumvallata.—This is due to a late outward proliferation of chorionic villi because the original area of the chorion frondosum was unduly small. As a result the chorionic villi later proliferate outwards into the decidua, beneath the ring of attachment of the amnion and chorion. A white ring is seen on the foetal aspect of the placenta,

and this bounds a central depression, from which the foetal vessels radiate and disappear under the white ring. This abnormality does not usually interfere with placental function.

Variations in the Attachment of the Umbilical Cord.—The umbilical cord is usually attached to the centre of the placenta, but sometimes it is eccentric, or attached to the edge of the placenta (*battledore placenta*). This is of no importance.



FIG. 16.—BATTLEDORE PLACENTA.

In rare cases the cord is attached to the membranes at some distance from the edge of the placenta, and at this point the vessels may divide into branches, which may run on the membranes for some distance before reaching the edge of the placenta (*placenta velamentosa*). This may be dangerous to the foetus if the vessels happen to pass across that part of the chorion that lies below the presenting part (*vasa prævia*), as a branch may be torn when the membranes rupture.

Placenta Accreta or Increta.—In the third stage of labour the placenta normally separates through a plane which runs through the thickness of the maternal decidua. The superficial part of the decidua comes away with the placenta, and the deeper part remains on the uterine wall. The layer of separation corresponds to the stratum spongiosum of the decidua. Normally the chorionic villi only penetrate into what corresponds to the stratum compactum of the decidua, and the loose stratum spongiosum therefore underlies the whole placenta.

If the chorionic villi invade more deeply the placenta is abnormally adherent and the condition is termed placenta accreta or increta.

In the former condition there is a solid fusion between the placenta and the decidual tissues, the spongy layer is absent and there is no plane of cleavage; in the latter the chorionic villi actually penetrate the uterine muscle so that the placenta and the uterine wall become

one solid continuous mass. Sometimes the area of adhesion is limited to part of the placental site, but in other cases the entire placenta is firmly attached. Morbid adhesion of the whole placenta occurs about once in 20,000 deliveries.

Clinically there is delay in the third stage, when the condition must be diagnosed from a separated placenta retained above a contraction ring and simple retention due to inefficient retraction of the uterus. In morbid adhesion of the whole placenta there is no bleeding, as no part of the placenta separates. Morbid adhesion of the placenta can only be recognized by failing to find a plane of cleavage when an attempt is made to remove it manually. If the adhesion is only partial it is usually possible to remove the placenta, but there is some risk of leaving part of it behind.

In cases of complete placenta accreta it may be possible to remove the placenta piecemeal; but this is a difficult and dangerous procedure. Unless hæmorrhage has been caused by attempts to remove the placenta, or the uterus has been damaged, when hysterectomy is inevitable, it may be justifiable to leave the placenta *in situ*, and await its separation by necrosis. Antibiotics should be given during this time.

DISEASES OF THE PLACENTA

Tuberculosis of the Placenta.—Tuberculosis in the foetal portion of the placenta is very rare. Local lesions have, however, been found in the decidua and in the chorion when the mother has generalized tuberculosis.

Syphilis of the Placenta.—The syphilitic placenta is, as a rule, heavier than the normal placenta; but increase in weight is not evidence of syphilis, as it may occur in other conditions. A macroscopic examination will not provide evidence of the disease, and it is only in microscopic sections that any evidence suggestive of syphilis will be found. In the syphilitic placenta the chorionic villi are larger, more numerous and crowded together, and often the vessels have disappeared. An obliterative endarteritis of the foetal vessels may occur and thickening is not infrequent in the coats of the vessels of the chorionic villi if they persist. The presence of the spirochæta pallida may be demonstrated, but not always easily.

Placenta in Erythroblastosis Foetalis.—In mild degrees of this condition no abnormality may be evident, though the placenta may be stained yellow with bile pigment. In hydrops foetalis the oedematous placenta is large, pale and friable and often as heavy as the foetus itself.

Degenerative Changes in the Placenta.—The placenta has a limited life span ; it is in active growth for about 30 weeks, and after that time degenerative changes are commonly found in it. In the past any degenerative change in the placenta was termed a placental “infarct”, but this term should be given up, as the abnormalities included under it bear no resemblance to the ordinary infarct of general pathology, which is due to occlusion of the artery supplying part of an organ. The chorionic villus is nourished by maternal blood flowing slowly in the intervillous space, which bathes its entire surface, and obstruction of the central foetal arteriole will not cause its death.

Fibrinoid degeneration.—In nearly every mature placenta white fibrinoid areas may be found near the periphery, or under the chorionic plate, or in the septa between cotyledons (“white infarcts”). Such areas are due to fibrinoid degeneration of trophoblast. Not all the trophoblast becomes effectively vascularized and these subchorionic and vascular “infarcts” are merely areas in which surplus trophoblast, which has never been effectively organized into villi, has degenerated. Such lesions do not interfere with foetal nutrition.

Intervillous thrombosis.—Another more important type of lesion is due to coagulation of maternal blood in the intervillous space. A “red infarct” is formed, consisting of coagulum enclosing villi whose blood supply has been cut off. In time such a lesion becomes organized, and forms a “white infarct” consisting of a mass of fibrin surrounding the degenerating villi. The cause of intervillous thrombosis is not always evident, but it may be due to damage to or senescence of the trophoblast, so that the surface is broken, and the blood clots. The slow blood-flow in the intervillous space is not enough to remove small clots, so that the thrombosis may extend. Small lesions are unimportant, and can probably be found in every placenta, but if large areas of the placenta are involved the foetal nutrition is disturbed.

Calcification of the Placenta.—Calcification is often observed on the maternal surface of the mature placenta in the form of numerous scattered gritty areas. Other small deposits may occur in areas of degeneration in the substance of the placenta. The common deposits on the maternal surface are in the decidua, and do not interfere with the maternal blood flow to the intervillous space. Such lesions are of no importance, but are sometimes a useful means of determining the position of the placenta in a X-ray photograph.

Cysts of the Placenta.—Small cysts may occur in the chorionic plate of the placenta, due to liquefaction in an area of fibrinoid degeneration. They are of no importance. Less frequently other small cysts may occur in areas of degeneration in the substance of the placenta.

Tumours.—Solid tumours of the placenta are rare, and consist of masses of chorionic villi with hypertrophy of the blood-vessels. In some cases the tumour is connected with the chorion by a pedicle containing an artery and vein. These vascular tumours are termed chorio-angiomata. As a general rule the remainder of the placenta is unaffected, but they may be associated with hydramnios, presumably due to exudation of fluid from the surface of the tumour. Very rarely secondary deposits from a primary carcinoma or melanoma in the mother occur.

ANOMALIES OF THE UMBILICAL CORD

Length.—The usual length of the umbilical cord is about the same as that of the foetus, viz. 50 cm. (20 inches), but considerable variations occur. Excessive length predisposes to descent and to the formation of coils and knots. The cord may be actually short or relatively short by being twisted round some part of the foetus. This may cause intra-uterine death of the foetus in the very rare cases, in which the cord is pulled tight. In labour delay during the second stage, rupture of the cord, premature separation of the placenta, or inversion of the uterus may occur. The treatment is to release the cord if wound round the neck after the head is born or, if necessary to clamp and divide the cord and hasten the birth of the child.

Knots may be formed as the result of foetal movements, the child passing through a loop which later forms a knot. Knots are rarely tight enough to obstruct the circulation, but occasionally they may lead to intra-uterine death of the foetus. Local protuberances of Wharton's jelly may give an appearance of knotting and have been described as false knots. They are of no practical importance.

Abnormal Insertions of the Cord.—The cord may be attached at the margin of the placenta, giving rise to the battledore placenta; it is without clinical significance.

Occasionally the cord is attached to the membranes, and the component vessels break up and branch before the placenta is reached. This anomaly is known as velamentous insertion (see p. 35).

CHAPTER V

THE FŒTUS

THREE periods may be distinguished in the development of the fœtus. *Ovular*—during the first 2 weeks; *embryonic*—during the 3rd to 5th weeks, when a definite form is assumed; *fœtal*—after the 6th week.

It is difficult to assess the age of the ova in early abortions, but generally the ovum at 4 weeks is about 2 centimetres in diameter and at 6 to 8 weeks about 5 centimetres. The length of the fœtus rather than its weight is probably a more reliable index of its age.

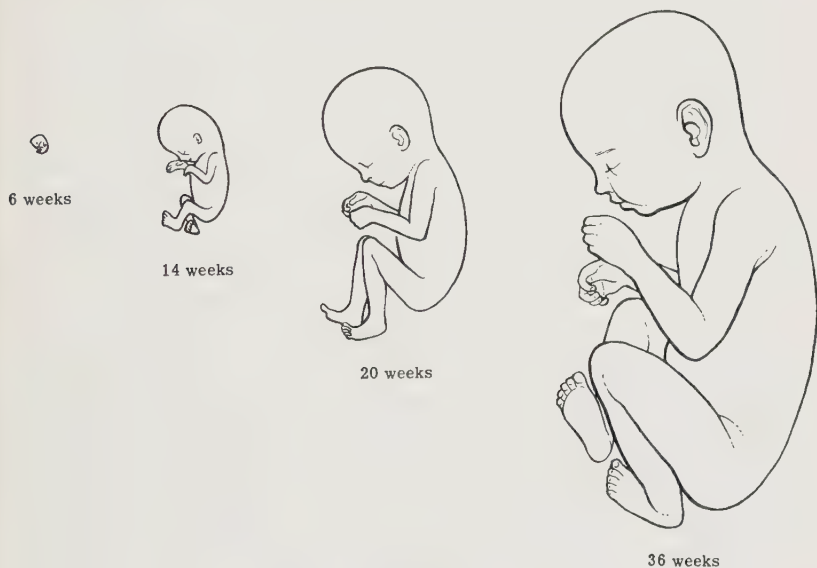


FIG. 17.

In describing the length of a fœtus, the measurements in the earlier weeks are commonly taken from the vertex to the coccyx, while from the end of the 20th week onwards the measurement is taken from the vertex to the heels.

At 12 weeks the measurement from vertex to coccyx is 7 centimetres or $2\frac{4}{5}$ inches.

At 16 weeks it is 12·5 centimetres or 5 inches.

At 20 weeks the total length from vertex to heel is 25 centimetres or 10 inches.

At 24 weeks it is 30 centimetres or 12 inches.

At 28 weeks it is 35 centimetres or 14 inches.

At 32 weeks it is 40 centimetres or 16 inches.

At 36 weeks it is 45 centimetres or 18 inches.

At 40 weeks it is 50 centimetres or 20 inches.

After the 20th week the fœtus increases roughly 5 centimetres or 2 inches each 4 weeks, and its length in inches is half the number of weeks of the duration of the pregnancy.

Other characteristics of the growing ovum from month to month are of value in determining the stage of development.

At 8 *weeks* the fœtus has taken on a distinctly human appearance. The 4-centimetre fœtus now lies in a much-enlarged amniotic cavity, the amnion being in contact with the chorion, and the extra-embryonic cœlom is obliterated. The ventral stalk and yolk-sac stalk have united to form the umbilical cord invested by the amnion, and the primitive small intestine is contained in the dilated proximal extremity of the cord. The chief human characteristics lie in the completion of the facial form, by the formation of the nose and its separation from the mouth. At this time also the ears are completely formed externally, and the eyelids have appeared around the eyeball. The limbs are enlarging, and show their jointed appearance, and the fingers and toes are formed. The flexion of the trunk is considerably diminished and the head is lifted up, so that the vertex now forms the upper end of the embryo rather than the back of the neck.

At 12 *weeks* the placenta has taken on its complete discoid form. The amnion entirely fills the chorionic sac; the umbilical cord, still short and thick, shows a spiral twist. The proximal portion of the umbilical cord has contracted, and the primitive small intestine is completely withdrawn into the body cavity. Nails have appeared on the fingers and toes, and the two sexes are differentiated so far as the external organs are concerned. The length of the embryo is 7 centimetres, and its weight is about 120 g. (4 ounces).

At the 28th *week* the fœtus weighs about 1400 g. (3 pounds). The subcutaneous fat is becoming more developed, so that the skin wrinkles begin to disappear. The testicles appear in the inguinal canals. The eyelids open. At this period the fœtus is said to be viable, and the law assumes that it can survive after birth; but the number of infants which survive such premature birth is very small.

After this stage the weight of the fœtus increases with comparative rapidity, but the extent to which it does so, and the exact weight at any particular time are unknown. Much depends upon the weight it would attain if it survived *in utero* until term. Thus a 6 pounds child at term would probably have weighed 5 pounds at the 36th, and

about 4 pounds at the 32nd week. A child, however, which at term weighs 12 pounds, probably weighed 10 at the 36th week. The foetus becomes completely covered with vernix caseosa, a greasy substance, composed of the secretion of sebaceous glands mixed with dead epidermal cells. The scalp-hair increases in length. Short, colourless hairs, known as lanugo, which have previously appeared on the body and head, tend to disappear. The red colour of the skin changes to that of flesh colour owing to the formation of fat. Just before the 36th week one testicle has usually descended into the scrotum. The nails reach the ends of the fingers but not of the toes. Most infants prematurely born at or later than the 36th week will survive.

At the *40th week* the foetus measures on an average 50 cm. (20 inches), and weighs as a rule between 2·7 to 3·6 kg. (6 to 8 pounds). The signs that the foetus has reached full time are not always clear, but the measurement and weight must be regarded as very important. In addition, the nails usually project beyond the finger-ends, and have reached the ends of the toes. The skin is not red as in a premature infant, but pink. The lanugo has almost disappeared except over the shoulders. The whole of the intestine contains meconium. The umbilicus is practically at the centre of the body. Both testicles have descended into the scrotum. As a rule, only one epiphysis has commenced to ossify, that in the lower end of the femur, but the centres of ossification of the upper epiphysis of the tibia and humerus may have appeared.

The weight of the full-time child is variable. Children weighing 4·5 kg. (10 pounds) are not uncommon, but children heavier than this are decidedly rare. If a really full-time child weighs under 5 pounds it is probably very badly nourished and feeble, and on this account has a poor chance of survival. It is different with twins; both may weigh under 2·25 kg. (5 pounds), and yet, being full-time and well nourished, are likely to survive. The heaviest children are born when the mother's age is between 25 and 35 years. The weight of the child tends to increase in successive pregnancies, provided the mother's age is below 35. Very young mothers commonly have small babies. Males are heavier than females on an average. There is no legal definition of what constitutes a full-time child, but a birth weight of 2·5 kg. (5½ pounds) is accepted as an international standard for the dividing line between maturity and prematurity.

The Fœtal Circulation.—The umbilical vein carries oxygenated blood from the placenta to the foetus. It enters the body at the umbilicus and divides into two branches, one of which joins with the portal vein to supply the liver; the other, which is named the ductus

venosus, passes directly into the inferior vena cava. The inferior vena cava also receives the blood from the liver, and that from the lower limbs and body-wall below the diaphragm. As the limbs and body-wall require but little blood, the amount from them, although venous, is not large enough to vitiate the pure blood from the ductus venosus to any great extent. This stream of oxygenated blood reaches the heart by the inferior vena cava. In the heart the stream is split into two by the crista dividens, which is the posterior edge of the interauricular septum; (a) part of the blood is directed into the left atrium through the foramen ovale, and (b) the rest of the blood passes through the tricuspid valve into the right ventricle.

At the same time venous blood is returning from the head and arms by the superior vena cava, and this blood is directed by the Eustachian valve through the tricuspid valve, where it joins the stream (b) just mentioned.

Thus the left atrium receives oxygenated blood through the foramen ovale, which is joined by the relatively small flow of venous blood in the pulmonary veins, and this blood is passed on through the mitral valve to the left ventricle.

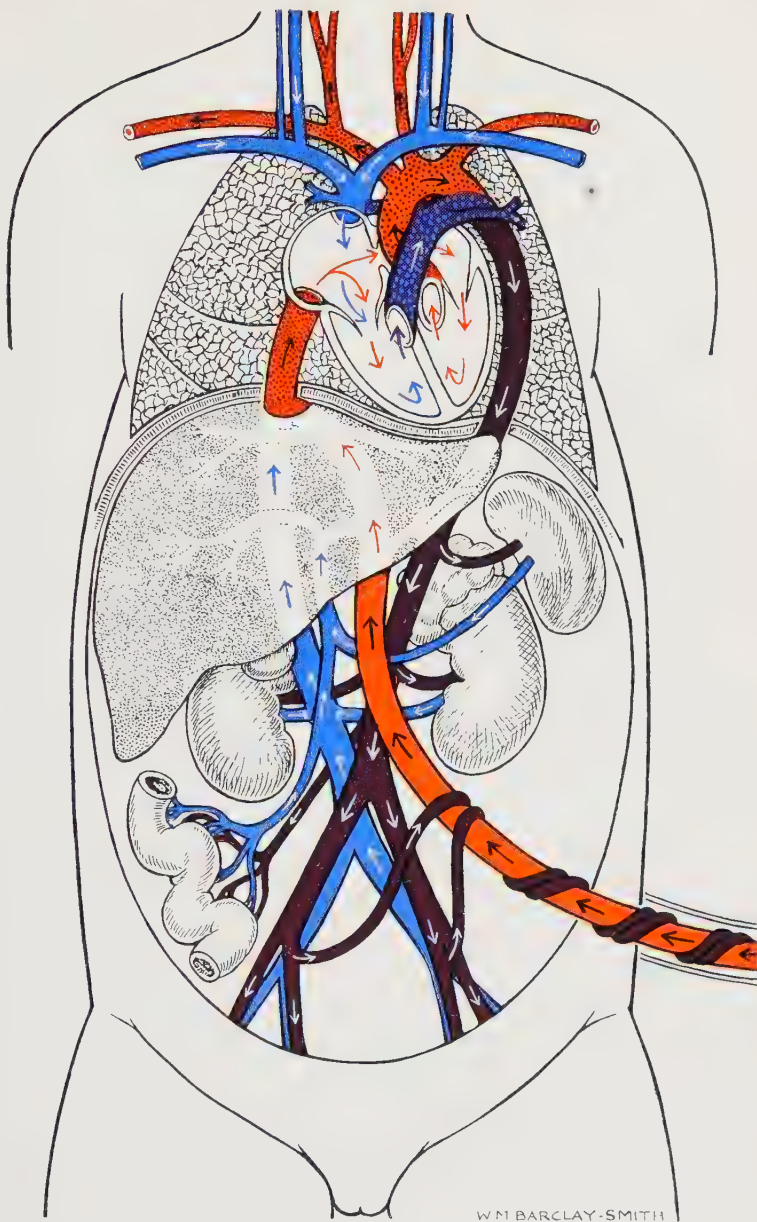
The right ventricle receives a mixture of oxygenated blood from the inferior vena cava and venous blood from the superior vena cava.

As both ventricles contract their contents pass up the aorta and pulmonary artery, but as the lungs are not expanded the ductus arteriosus allows some of the blood in the pulmonary artery to enter the aorta instead of passing through the lungs. It will be seen that the blood in the carotid arteries, supplying the developing brain, is better oxygenated than the blood going to the rest of the body, with the exception of the liver.

The greater part of the blood descending in the aorta leaves the body by the hypogastic (umbilical) arteries to be fully oxygenated again in the placenta.

Changes in the Fœtal Circulation at Birth.—The first important change is brought about by the respiratory efforts of the child directly after birth. The inflation of the lungs immediately determines the necessity for a large supply of blood to them through the pulmonary arteries. This diverts the blood-current from the ductus arteriosus, which rapidly loses its lumen and becomes impervious. Experiments on the fœtus of the sheep show that closure of the ductus arteriosus occurs in two stages, a physiological one that takes place within a few minutes of respiration commencing and an anatomical occlusion that requires a considerable time for its completion.

The blood returning from the lungs is now oxygenated instead



THE FŒTAL CIRCULATION.

of venous, and entering the left auricle it passes into the left ventricle, and is then distributed all over the body by the aorta and its branches. The sudden cessation of the placental circulation deprives the umbilical vein and ductus venosus of their blood-current, and consequently within an hour they collapse and empty, and subsequently gradually atrophy, becoming converted into fibrous cords. The umbilical (hypogastric) arteries, being cut off from the placenta at the umbilicus, cease to carry any blood and close, but they can be still recognized in the adult as the obliterated hypogastric arteries.

The contraction in the two umbilical arteries in the cord occurs within a few moments of the first breath and they soon cease to pulsate and so prevent any further blood leaving the child. The umbilical vein remains open for a slightly longer period, thus allowing a large quantity of placental blood to be returned to the child. It has been shown that 50 ml. of blood return to the child within a minute after birth and as much as 100 ml. within half an hour, if the cord is not tied.

The alteration in the course of the blood-stream through the heart from auricle to ventricle on each side, instead of from the right auricle to the left auricle *via* the foramen ovale, throws the latter aperture out of function. The foramen ovale ceases to give free passage to blood immediately after birth, but the anatomical completion of the inter-auricular septum is not effected for some months. The hypogastric arteries are usually occluded by the second day but occasionally the lower portion may remain patent.

Oxygen Supply to the Fœtus.—As the fœtus grows it requires ever increasing amounts of oxygen. The placenta becomes more permeable as pregnancy proceeds, but in addition the fœtal blood has the advantage of being able to take up more oxygen per unit volume than the maternal blood. This is possible because the fœtal blood at full time contains more hæmoglobin per millilitre and also because the fœtus has a hæmoglobin of slightly different chemical constitution.

The fœtal red cell count rises progressively from 1·5 million per cu. mm. at 10 weeks to 5·5 million at term. The cells are macrocytic, and the hæmoglobin content at term is about 18 g. per 100 ml. (130 per cent. Haldane). The maternal blood at term often contains 12 g. per 100 ml. (85 per cent.).

The fœtal hæmoglobin is mostly formed in the liver and spleen rather than in the bone marrow, and contains a different globin; it has the property of being able to combine with more oxygen than adult hæmoglobin, especially at low oxygen tensions.

The effect of these differences between maternal and fœtal blood is that 100 ml. of maternal blood can carry 16 ml. of oxygen if it is fully

saturated, but the same volume of foetal blood can carry 21 ml. In other words, the foetal blood can easily take up oxygen from the maternal blood. In the outcome, as maternal arterial blood is nearly fully saturated it carries about 15·7 ml. of oxygen per 100 ml., and as foetal arterial blood is only about 50 to 60 per cent. saturated it carries between 11 and 13 ml. of oxygen per 100 ml.

Nutrition of the Fœtus.—Although it is of course completely dependent on the maternal blood and the placenta for its requirements, the foetus is a separate physiological entity, and it will take what it needs from the mother, even at the cost of reducing her reserves of some substances, for example calcium and iron. The details of foetal metabolism need not concern us here, except to point out that for nearly every substance that the foetus requires the rate of uptake rises progressively, and is greatest in the late weeks of pregnancy, as the following table shows :

CONSTITUTION OF THE FŒTUS (grams)

<i>Weeks</i>	<i>Weight</i>	<i>Nitrogen</i>	<i>Phosphorus</i>	<i>Calcium</i>	<i>Magnesium</i>	<i>Chlorine</i>	<i>Sodium</i>	<i>Potassium</i>
16	100	0·9	0·1	0·2	0·04	0·2	0·2	0·1
24	600	6·8	1·6	3·1	0·2	1·4	1·2	0·8
32	1700	23·4	5·9	8·5	0·3	3·0	2·8	2·3
40	3400	55·9	12·9	22·7	0·5	5·1	5·0	4·7

CHAPTER VI

CHANGES IN MATERNAL ANATOMY AND PHYSIOLOGY DURING PREGNANCY

ALTHOUGH the anatomical and physiological changes that occur during pregnancy chiefly involve the genital tract and the breasts, many other inter-related changes occur in other systems of the body. All these changes are initiated by hormones produced by the foetal chorionic tissue. The most important alterations in maternal physiology during pregnancy may be summarized thus:—

1. *Hormonal changes.*—Placental, and perhaps other, hormones maintain the decidua, initiate the growth of the myometrium, increase the vascularity of the whole genital tract, and cause proliferation of the glandular tissue of the breasts. These hormones have other secondary effects, including the retention of water in the body, relaxation of smooth muscle especially in the urinary tract, and possibly relaxation of pelvic ligaments.

2. *Changes due to the uterine enlargement.*—The increased blood-flow through the uterus, causes great changes in the maternal circulation, and the enlarged uterus alters the general posture and affects the mechanism of respiration.

3. *Metabolic changes.*—The foetal requirements of oxygen and food substances, and the growth of the uterus and preparation for lactation, affect the mother's metabolism and dietary needs. We may now consider some of these changes in detail.

Endocrine System.—(a) *Foetal Hormones.*—We have already described how the foetal trophoblast produces large amounts of chorionic gonadotrophin, especially in the first trimester of pregnancy (see p. 12). During pregnancy large quantities of this hormone are present in the blood and urine, and it is believed that high concentrations of this substance prolong the life span of the corpus luteum, which in turn continues to produce oestrogen and progesterone and so to maintain the uterine decidua until the output of oestrogen and progesterone from the placenta rises.

Large amounts of oestrogens and progesterone are found in the blood and urine during pregnancy, at first secreted by the corpus luteum, but chiefly from the placenta after the 12th week. Even if the corpus

luteum is removed in early pregnancy the hormone levels continue to rise, and it has been shown that the placenta contains large quantities of these hormones. Œstrogen and progesterone maintain the decidua of pregnancy, cause the growth and hyperæmia of the uterus and lower genital tract, and the hyperæmia and development of the breasts.

(b) *Other maternal endocrine changes.*—During pregnancy the anterior lobe of the pituitary gland undergoes hypertrophy, with increase of both acidophil and basophil cells. No anatomical changes are evident in the posterior lobe of the pituitary gland.

The thyroid gland is slightly enlarged during pregnancy, and the basal metabolic rate is increased.

There is an increased concentration of adrenal gluco-corticoid hormones in both the blood and the urine, and there is some evidence that the placenta secretes an adreno-corticotrophic substance. During pregnancy the number of eosinophil cells in the blood falls. The observation that rheumatoid arthritis often undergoes a remission during pregnancy may be explained by the increased secretion of gluco-corticoids. There is also some increase in the excretion of mineralo-corticoids (aldosterone).

The Uterus.—During pregnancy the uterus is adapted to contain the growing foetus and placenta, and it also undergoes changes in preparation for its task of expelling the foetus during labour. The changes include development of the decidua (see. p. 19), hypertrophy of the muscle coat, increased vascularity, formation of the lower segment, and softening of the cervix.

At term the uterus is 30 to 35 cm. (12 to 14 inches) long, and about 23 cm. (9 inches) in diameter. It weighs 1 Kg. (2 pounds), in contrast to the non-pregnant uterus which weighs 65g. (2 ounces). The uterus soon becomes too large to remain in the pelvic cavity; the fundus of the uterus reaches the level of the top of the symphysis pubis at about the 10th week, and thereafter it lies against the anterior abdominal wall, displacing the other viscera to the side or back of the abdominal cavity. The fundus reaches the level of the umbilicus at about the 22nd week, and the xiphisternum at about the 36th week. The fundus may then sink down somewhat, especially in cases in which the foetal head descends deeply into the pelvis during the last 4 weeks. After the 20th week the average upward growth of the uterus is 3.75 cm. ($1\frac{1}{2}$ inches) per month.

The pregnant uterus is usually rotated slightly on its long axis, so that the anterior surface faces a little to the right, and the fundus may also be inclined to one or other side, most often the right. At term the main axis of the cavity of the uterus is at a right angle to the plane of

the pelvic brim. The enlargement of the uterus is greatest at the fundus, so that the points of entry of the Fallopian tubes appear to lie well below the top of the uterus.

The enormous growth of the myometrium during pregnancy is due to two factors—hormonal stimulation and distension. During early pregnancy the embryo does not fill the uterine cavity, and distension has no influence at this stage. An identical uterine enlargement occurs in cases of ectopic pregnancy when the embryo is outside the uterus. The growth is brought about by the action of oestrogen and progesterone. Later on, as the foetus and placenta become larger, the distension of the uterus provides a further stimulus to growth.

In early pregnancy active mitosis can be seen in the connective tissue and muscle cells, and the enlargement of the uterus is largely due to an increase in the number of cells. Later in pregnancy the enlargement is chiefly due to hypertrophy of the individual cells, and cell division is less active. At full time each muscle cell is about 10 times as long as it was before pregnancy. The blood-supply to the uterus is greatly increased, and especially under the placental site the veins become converted to large sinuses, thicker than a pencil. Section of the nerve supply to the uterus has no effect on the growth of the uterus in pregnancy.

At the 12th week of pregnancy the body of the uterus is roughly spherical. Examination of the uterus at this stage will show that the lowest part of the body of the uterus, the part just above the internal os, forms a short narrow canal, sometimes termed the isthmus. At first the isthmus does not contain any part of the embryo, but as pregnancy proceeds the isthmus becomes stretched, and the embryo comes to occupy this part of the body of the uterus as well as the main cavity. The isthmus thus forms the *lower uterine segment*, and this is the part of the body of the uterus which will be stretched during labour by the more powerful contractions of the upper segment. In many cases the formation of the lower segment begins in late pregnancy and before labour starts, and at this stage the lower part of the uterine cavity has the form of a half sphere, with the internal os at its lowest point. During labour this half sphere will be converted into a cylinder which is continuous with the cervical canal. In most cases the lower segment is represented by that part of the full-time uterus which is within a radius of 7.5 cm. (3 inches) from the internal os, but it must be recognized that the distinction between the upper and lower uterine segments is physiological, rather than one that is capable of precise anatomical definition.

At term the wall of the uterus appears thin in relation to the enormous enlargement of the cavity, but in fact it is still about 1 cm. (just under

half an inch) thick. In late pregnancy it is possible to define three layers in the muscular wall of the uterus :

(1) There is a thin outer layer of fibres that arch over the fundus, and elsewhere are continuous with the muscle of the round ligaments.

(2) There is a thick intermediate layer, consisting of a meshwork of interlacing fibres, which pass around the blood-vessels. The contraction of this layer will stop the blood-flow in the vessels, and it is the strong contraction of this layer which prevents dangerous hæmorrhage from the large placental sinuses in the third stage of labour.

(3) The inner layer is thin, and arranged in a circular fashion, especially around the internal os and around the tubal openings.

During pregnancy the uterus contracts from time to time (Braxton Hicks contractions), and contractions can be stimulated by handling the uterus. The contractions are not so strong or so sustained as those of labour, and are painless.

The peritoneal coat grows to keep pace with the enlargement of the uterus. It preserves its usual relations to the uterus in front and behind, but at the sides the gradual distension of the lower segment has the effect of separating the layers of the lowest part of the broad ligament, so that its level is raised and a larger area at the side of the uterus is uncovered by peritoneum than in the non-pregnant organ.

The ovarian and uterine arteries and veins are greatly enlarged, and the latter become straighter in their course up the side of the uterus.

The Cervix.—Although the cervix hypertrophies to some extent during pregnancy, it does not do so to anything like the same extent as the body of the uterus. Three important changes occur in it, namely, the hypertrophy of the glands of the cervical canal, the softening of the cervix, and the bluish colour that it assumes. Softening of the cervix begins in the early weeks, but its degree varies. It is due to increased vascularity and to a great increase in the gland spaces. The glands are distended with mucus, and the pattern of the glands becomes far more complex, so that the cervix seems to contain a honeycomb filled with mucus. This is sometimes described as a mucus plug, but the mucus is in the gland spaces, not free. The bluish colour is due to venous congestion, and appears earlier than the similar appearance in the vagina.

The cervical canal is normally still present at the end of pregnancy, although in many multiparæ the external os is patulous. An intact and effective internal os is of importance in retaining the embryo safely ; with an incompetent cervix there is a considerable risk of abortion, or of premature rupture of the membranes.

Because of the great activity of the columnar epithelium of the cervix, and the increased secretion of mucus, it is common for the

stratified epithelium on the vaginal surface of the cervix to be replaced by an outward extension of the columnar epithelium—one type of cervical erosion. Such an appearance is hardly to be regarded as abnormal during pregnancy, and it will usually disappear in the puerperium.

Vagina and Vulva.—The increased vascularity already described in the cervix affects the vaginal walls a little later, and they eventually show the violet coloration right down to the vulva. The vaginal walls become softened and relaxed, and the same change occurs in the perineal body.

The watery transudation that normally occurs through the vaginal wall is increased during pregnancy. The hypertrophied cervical glands secrete more mucus, and this is added to the vaginal transudate and desquamated vaginal cells, so that the total discharge from the vagina is increased. The secretion is usually acid in reaction (pH 4.5 to 5) and is some protection against ascending infection.

As pregnancy advances the vulva shares in the increased vascularity, and shows some swelling in consequence. The violet colour is seen on the moist surfaces around the urethra and inner parts of the labia minora, and varicose veins may appear.

Breasts.—During pregnancy the secretion of oestrogen in large amounts causes activity and thickening of the skin of the nipple, and active growth and branching of the underlying ducts. The added action of progesterone causes further hyperæmia, and proliferation of the glandular epithelium of the alveoli. Neither of these hormones causes the active secretion of milk, which only begins after delivery, when the level of oestrogen falls and another hormone—prolactin from the anterior lobe of the pituitary gland—is secreted.

Slight changes in the breasts occur in the menstrual cycle, under the influence of oestrogen and progesterone, and the breasts may become tense and uncomfortable for a few days before the onset of the period. If pregnancy occurs these changes are more marked. The earliest change is a swelling of the breasts, especially at the periphery. The lobules of the gland can be felt easily and are harder than normal, these changes producing a knotty feeling in the breast. At the same time the breasts become a little tender, and the patient often describes a “prickly” sensation in them. The increased blood-supply is shown by a very obvious network of veins under the skin. As a result of congestion, followed by actual growth of the glandular tissue, the breasts become more prominent.

By about the 12th week of pregnancy the glands begin to secrete an almost clear fluid, which can be made to appear at the nipple in

droplets if the breast is squeezed towards the nipple. Towards the end of pregnancy the secretion becomes more copious and is yellow in colour and creamy in consistence. It is then known as colostrum, and consists of water, fat, albumin, salts and colostrum corpuscles. The latter are cells shed whole from the gland acini, and filled with fat droplets. When the milk secretion is eventually established colostrum corpuscles are not found in it, because the fat is discharged from the secreting cells into the lumina of the acini, and the cells themselves are not detached.

Changes also occur in the nipple, which becomes larger and more readily erectile. The areolar skin is active and slightly raised above the surrounding skin. The areola becomes pigmented to a greater or less degree, the change being most marked in brunettes. Once the pigmentation has occurred it persists as a permanent change. The sebaceous glands on the areola are very active in pregnancy, and can be seen as a ring of about 12 to 20 small tubercles (Montgomery's tubercles).

At about the 20th week of pregnancy, in dark skinned women, further pigmentation may occur on the skin beyond the margin of the areola. This is termed the secondary areola, and is not a uniform pigmentation, but takes the form of patchy streaks. The secondary areola is not a permanent change, and it disappears after pregnancy.

The stretching of the skin over the breasts may produce striæ like those which occur on the abdomen (see below).

Sometimes outlying lobules of mammary tissue are found in the axillæ; they enlarge during pregnancy and may form comparatively large swellings. Sometimes such breast tissue has inadequate drainage to the main duct system, and so may become tense and painful when lactation begins.

Abdominal Wall.—The muscles of the abdominal wall become stretched to accommodate the enlarging uterus, and although in perfect health subsequent recovery is complete, in not a few multiparæ some loss of tone of these muscles persists. In late pregnancy the umbilicus may be flattened out, or even protrude.

Stretching of the abdominal skin may cause the formation of striæ gravidarum. These are due to rupture of the elastic fibres of the skin, and they appear as curved lines, roughly concentric with the umbilicus, which may extend to the loins or thighs, and may sometimes occur on the breasts. At first the striæ are pink or red, but after delivery they become silvery-white, and are then called linæ albicantes. After the first pregnancy the striæ are apt to become pigmented in any subsequent pregnancy. Not all women develop striæ; perhaps one-

third do not. It is unusual to see striæ in other conditions in which the abdominal wall is stretched, such as large ovarian cysts, ascites or gross obesity, though they are occasionally seen in such cases. The fact that they are frequently seen in Cushing's syndrome, when there is a high level of glucocorticoids in the blood, as there is in pregnancy, has led to the suggestion that the striæ are partly due to the action of these hormones.

Pigmentation of the line from the pubes to the umbilicus (the *linea nigra*) may be seen in dark-skinned women during pregnancy, and tends to persist in part after the pregnancy.

Pelvic Joints.—The pēlvic hyperæmia causes some softening and slight relaxation of the ligaments of the sacro-iliac joints, and of the ligaments and fibro-cartilage of the symphysis pubis, and the mobility at these joints is slightly increased in pregnancy. In some animals a specific hormone relaxin, probably derived from the ovary, causes relaxation of the pelvic joints, but it is uncertain whether such a hormone plays any part in human physiology.

The changes so far described have mostly been those directly related to the genital tract and the breasts. Numerous other changes occur in the rest of the body, and nearly every system is involved in some change. Yet pregnancy is a physiological and not a pathological process, and many women both feel and appear to be in better general health during pregnancy than at other times. Given good previous nutrition and sound emotional adjustment, the physiological changes of pregnancy are not to be regarded as a strain on the mother's health, but merely as a temporary adaptation to a normal activity.

Maternal Metabolism during Pregnancy.—*Weight gain.*—The body-weight increases during pregnancy. The total gain varies between 14 and 34 pounds in normal cases, with an average of 24 pounds. Of this total only about 2 pounds are gained during the first trimester; the subsequent average normal gain is of 0·8 pounds per week.

A total gain in weight of 24 pounds would largely be due to the weight of the foetus and the structures that support it. A foetus weighing $7\frac{1}{2}$ pounds, a placenta of 1 pound, amniotic fluid weighing $1\frac{1}{2}$ pounds, a uterus of 2 pounds, and an increase in the weight of the breasts of about 2 pounds would account for a total gain of 14 pounds. The remaining gain of 10 pounds represents the weight gained by the rest of the maternal tissues, and this is partly due to fluid retention (3 pounds), and partly due to increase in the body fat and protein.

During pregnancy, apart from the fluid retained in the foetal tissues, there is some retention of fluid in the maternal tissues, chiefly in the

extracellular components, including the blood-plasma (see below). Corresponding quantities of sodium are retained, and at present it is believed that this retention of salt and water is due to the high concentrations of sex steroids during pregnancy, although the part played by suprarenal mineralo-corticoids has not yet been fully investigated.

In cases of pre-eclamptic toxæmia there may be an abnormal gain of weight due to retention of fluid (see p. 173).

Metabolic changes.—The total metabolic rate of the pregnant woman is increased by between 5 and 25 per cent., but if allowance is made for the foetal metabolism the basal metabolic rate of the maternal tissues is probably unaltered.

The total need for calories during pregnancy is increased, but not always to the degree that the patient's appetite may suggest. Apart from fluid retention in cases of pre-eclamptic toxæmia, abnormal weight gain during pregnancy and the puerperium is often due to simple overeating, chiefly by an excessive intake of carbohydrate.

During pregnancy the renal threshold for the excretion of sugar from the blood is sometimes lowered, so that glucose may appear in the urine although the blood-sugar is normal. This condition is of no importance, but it must be distinguished carefully from diabetes, by a blood-sugar curve if necessary (see p. 282). Patients with a simple lowering of the threshold are not prone to develop diabetes later. The escape of sugar may only be the result of an increased rate of glomerular filtration, which allows so much sugar to enter the tubules that they fail to absorb it sufficiently.

Lactose may appear in the urine during lactation, but it is hardly ever found during pregnancy.

During pregnancy a high protein intake is required to supply the growing foetus, placenta, uterus and breasts. Yet during pregnancy large quantities of nitrogen are retained, over and above the amounts required by these structures.

Changes in fat metabolism during pregnancy are less well understood, but the blood fat content is slightly increased, and there is a greater tendency to ketosis if there is any disturbance of carbohydrate metabolism.

The maternal diet must not only supply the protein, carbohydrate and fat required, but also the essential minerals and vitamins. An ordinary diet provides adequate amounts of most of these substances, but in the case of two substances, iron and calcium, there is some risk of a deficit, particularly in the last trimester when the foetal uptake is greatest. The foetal body at term contains about 25 g. of calcium, but even with this large demand a mother with a first-class diet will increase her calcium reserve during pregnancy. However, with a less

favourable diet there may be a deficiency during the last trimester of pregnancy, when over two-thirds of the foetal uptake occurs, and this deficiency is supplied by some degree of calcification of the maternal skeleton and dentine.

In the case of iron only about 1 mg. of iron is assimilated per day, an amount insufficient to meet the foetal needs, which may reach 4 mg. daily in late pregnancy. In addition the mother herself forms extra red cells during pregnancy. The blood-volume is increased, and although the amount of hæmoglobin per millilitre may be reduced, the increase in blood-volume outweighs this, so that the total amount of hæmoglobin in the maternal body is in fact increased. Even in health, and with a normal diet, the maternal iron reserves in the liver, spleen and marrow, may therefore be reduced in pregnancy. Not all the iron so used is lost; apart from the hæmoglobin of the foetus and the maternal blood lost at delivery, the iron built up into excess maternal red cells during pregnancy is later returned to the reserves. The details of the changes in the maternal blood may now be discussed.

Changes in the Blood.—The total blood-volume is increased during pregnancy by about 30 per cent. The uterus, and the maternal blood spaces in the placenta, contain a large volume of blood, perhaps 800 ml. The increase in blood-volume is an adaptation to supply the needs of this new vascular bed. Although the total number and volume of red cells increase, the plasma volume increases to a relatively greater extent, with the result that the blood appears to become more dilute, and the red blood cell count and hæmoglobin concentration fall. A red cell count of 4 million per c.mm. and a hæmoglobin concentration of 12 g. per 100 ml. (80 per cent.) are usually accepted as normal during pregnancy. Yet in spite of the fact that such levels are commonly observed in apparently healthy women in pregnancy there is much evidence to show that if the iron reserves are high before pregnancy, which is seldom the case, or if added iron is given in a form that is well absorbed, then the red cell count and hæmoglobin concentration will remain much higher.

A very high leucocytosis is often observed in labour and the early puerperium, but not during normal pregnancy, when the count does not exceed 11,000 per c.mm. The platelet count is normal. The erythrocyte sedimentation rate is much increased in normal pregnancy.

Changes in the Circulation.—The cardiac output rises considerably during pregnancy, usually rising about 50 per cent. by the 30th week. The output does not then rise much further, and after the 36th week there is a steady fall in the output, so that at full time it is little above the normal level. This point is of practical importance in the

management of cases of cardiac disease in pregnancy, for in the last month of pregnancy the risk of failure is much less than in the period between the 30th and 36th weeks.

The blood-pressure does not rise in normal pregnancy—indeed it may fall slightly in the middle trimester—and the pulse-rate is not significantly altered, so that the increased cardiac output must be achieved by the expulsion of an increased volume of blood from the heart at each beat. This extra cardiac work is well within the reserve of the normal heart, and little hypertrophy is evident. The heart is displaced upward in late pregnancy, and the apex is rotated outward, so that the apex beat is displaced outward and the electrical axis is altered. There may be left axis deviation and inversion of the T-wave in an electrocardiograph, but there is little evidence of muscular hypertrophy.

The large blood flow through the uterus may be regarded as an arterio-venous shunt across the main circulation, and the increase in cardiac output and in the blood volume may be related to this. In addition there is some dilatation of the peripheral vessels; the hands and feet are often noticeably warm during pregnancy, and the capillaries of the skin can be shown to be dilated.

The enlarging uterus interferes with the venous return from the legs, so that there is some stasis in the large veins, and slight œdema of the ankles may occur, even in normal cases. Hæmorrhoids and varicose veins may appear for the first time or become worse during pregnancy.

Changes in the Respiratory System.—Some breathlessness is common in normal pregnancy, especially just before the 36th week. After that, if the foetal head descends into the pelvis, the breathlessness is often less, a change that the patient may describe as “lightening”. During late pregnancy the diaphragm is elevated and the lower ribs are lifted outward. The pulmonary ventilation is increased, but the vital capacity is not reduced.

Changes in the Alimentary Tract.—The most striking change in the digestive function in pregnancy is morning sickness, but this only occurs in about 50 per cent. of pregnant women. As a rule it begins at the 6th week and stops spontaneously before the 14th week. It is generally limited to the early morning, when the patient feels sick or vomits immediately after she gets out of bed. Most women have no further sickness during the rest of the day, but in a few instances the nausea recurs at intervals, or may only occur in the evening. In the morning the vomit usually consists of only a little bile-stained mucus. So long as the vomiting is confined to the morning and little food is

lost, and provided that it stops before the 14th week, it is of little consequence, and hardly to be regarded as abnormal, but cases of excessive or prolonged vomiting are certainly pathological. (See *Hyperemesis Gravidarum*, p. 201.)

The cause of morning sickness is not certainly known. The most acceptable of the many theories that have been brought forward to explain this symptom is that it is due to the high level of chorionic gonadotrophin in the blood in early pregnancy. The concentration of gonadotrophin falls considerably after the 12th week, when the vomiting starts to improve. Sickness is more severe in cases of twins and of hydatidiform mole, in both of which the level of gonadotrophin is high.

The fact that morning sickness, or at least nausea, occurs in so many pregnant women, and only troubles them in the morning, are obvious objections to the idea that it is entirely due to neurosis. On the other hand, the exaggeration of this symptom to become excessive and prolonged vomiting is sometimes due to a neurosis (see p. 201).

As a rule the appetite is good during pregnancy, but minor digestive upsets are common. Sometimes gastric or intestinal distension occurs, and especially in early pregnancy this causes a feeling of abdominal enlargement, which may give rise to a false idea of the stage to which the pregnancy has advanced. Heartburn is a common complaint, and is due to some degree of relaxation of the cardiac sphincter of the stomach. In a few of the more severe cases this symptom is found to be due to the presence of a hiatus hernia of the diaphragm. The emptying time of the stomach is prolonged during pregnancy (and even more so during labour, a fact that is of considerable importance with respect to the risk of vomiting during anaesthesia). The gastric acidity is often reduced during pregnancy.

Constipation is a common symptom, and this, together with the pelvic hyperaemia and the pressure of the enlarging uterus, may lead to the formation or increase in size of hæmorrhoids.

Changes in the Urinary Tract.—Frequency of micturition occurs in the first 12 weeks of pregnancy, when the enlarging uterus is still in the pelvic cavity and rests on the bladder. It may also occur in the last month of pregnancy when the presenting part is engaging in the pelvis.

Important changes in the renal tract can be seen if an intravenous pyelogram is performed during pregnancy. From about the 16th week of pregnancy onwards, there is considerable and progressive dilatation of the renal pelves and of the ureters down as far as the level of the pelvic brim; these changes are usually greater on the right side. Direct measurement of the intra-ureteric pressure shows that it is lowered rather than raised, and the dilatation is chiefly due to loss of muscle

tone, although pressure by the enlarging uterus may explain the greater degree of change on the right side. These changes are important in relation to pyelitis in pregnancy (see p. 256). The dilatation disappears during the puerperium, so long as there is no infection of the tract. It is thought to be due to placental hormones, probably progesterone.

Changes in the Skin.—Many changes in the skin can be seen during pregnancy. The *striæ gravidarum* and *linea nigra* of the abdomen, and the primary and secondary areolæ of the breast, have already been mentioned.

Pigmentation also occurs on the face, as irregularly shaped brown patches, known as the *chloasma*, or the mask of pregnancy. Such patches completely disappear after delivery. The cause of the widespread pigmentation in pregnancy is not certainly known, but it may be related to suprarenal hormones.

Small spider *nævi* often appear temporarily during pregnancy, and also palmar erythema, and these are due to the high level of *œstrogens*.

Changes in the Nervous System.—Changes in emotional disposition frequently occur in pregnancy, and are to be expected as the mother is developing a new set of relationships to her expected child. A woman who is pleased to bear her child is usually contented and happy, but in the case of a patient who does not really welcome the pregnancy, and perhaps resents the responsibility and alteration of her life that its coming entails, numerous symptoms of emotional origin may appear, and she will make the worst of any discomfort, such as morning sickness. In general, such changes are trivial, and any gross change in personality or behaviour should be regarded more seriously, as a possible indication of mental illness.

Peripheral neuritis due to deficiency of vitamin B₁ (aneurine) is a rare complication of pregnancy, but hardly to be included as a normal physiological change. A more common disorder is *acroparæsthesia* of the hands, in which there is a sensation of pins and needles with some sensory loss, and sometimes evident weakness of the small muscles of the hands. The patient finds it difficult to use her hands for fine work. *Acroparæsthesia* has been attributed to *œdema* in the carpal tunnel involving the median nerve, and this may explain the cases in which the signs have the appropriate distribution, but in other cases the ulnar border of the hand is chiefly involved, and sometimes even the forearm, and in these cases pressure on the lowest part of the brachial plexus near the first rib must be considered. There may be some sagging of the shoulder girdle in pregnancy, sometimes due to enlargement of the breast,

CHAPTER VII

CLINICAL SIGNS AND DIAGNOSIS OF PREGNANCY

The Duration of Pregnancy.—In cases in which pregnancy has followed a single coitus the average duration of pregnancy from the date of intercourse is 269 days. If the calculation is made from the first day of the last menstrual period the average duration is 282 days, and these observations support the belief that ovulation most frequently occurs at the 13th day of the menstrual cycle. However, there is considerable variation in the duration of apparently normal pregnancy, even in cases in which the menstrual cycles were previously regular and of normal length, and also in cases in which the date of a single coitus is known. The method of estimating the probable date of delivery is discussed below (see p. 66).

SYMPTOMS OF PREGNANCY

Amenorrhœa.—Amenorrhœa is the earliest symptom of pregnancy. In a healthy woman whose menstrual periods were previously regular, if there is a sudden cessation of the periods the presumption must always be that she is pregnant unless some other cause can be found. Amenorrhœa has not the same significance in the case of a woman whose periods were previously irregular, nor may it have any significance in a woman of menopausal age. On the other hand, pregnancy has been known to occur in a young girl before a menstrual period has been observed, and it may arise during a period of amenorrhœa, for example during lactation.

Difficulty can also arise if there is bleeding during early pregnancy. Such bleeding may come from the cavity of the uterus at the stage before the decidua capsularis fuses with the decidua vera, but is not to be regarded as menstrual bleeding. Although a pregnancy accompanied by slight bleeding in the early weeks may prove to be quite normal, such bleeding should always be viewed as a threat to miscarry.

Morning Sickness.—Morning sickness may start at the 6th week. It is not seen in all pregnant women, and it may be due to other causes, such as alcoholic dyspepsia.

Breast Symptoms.—In the first 4 weeks of pregnancy the patient may notice some tenderness of the breasts, and some fullness. These

symptoms are far from constant, and these too may be due to other causes, such as chronic mastitis.

Frequency of Micturition.—During the first 12 weeks, when the uterus is still a pelvic organ, there is often some frequency of micturition, because the enlarging uterus presses on the bladder slightly.

Abdominal Enlargement.—Many women state that they notice some abdominal fullness in early pregnancy, at a stage when the uterus is not much enlarged. Such a symptom at this stage can only be due to slight intestinal distension. Later on the uterine enlargement becomes evident, and sometimes it is this that first brings the patient to the doctor, especially in a case in which the menstrual history was irregular. On the other hand, a woman sometimes considers herself to be pregnant because of an abdominal swelling due to some other cause, such as fat.

Quickening.—The pregnant woman usually first notices movements of the foetus at between the 18th and 20th weeks of pregnancy, but multiparæ may recognize the movements about 2 weeks earlier. At first the movements are slight, and may be confused with movements of wind in the intestine. This symptom is not of much value in the diagnosis of pregnancy, as the patient who believes herself to be pregnant will often declare that she feels movements. It is of more use when the possibility of foetal death has arisen in late pregnancy, but even here the patient's statements may be coloured by her hopes or fears.

SIGNS OF PREGNANCY

It will be seen that it is not possible to establish a certain diagnosis of pregnancy from any of the symptoms given above, although a combination of them may be strongly suggestive. In every case a proper examination to discover confirmatory physical signs is required. The clinical diagnosis of pregnancy, especially in the first half of pregnancy, depends on a combination of symptoms and signs. Only when the pregnancy has advanced far enough for the parts of the foetus to be felt clearly, for the foetal movements to be palpable, or for the foetal heart to be heard, can the signs be said to be absolute. Other signs are termed presumptive.

It may be mentioned here that demonstration of the foetal skeleton by X-ray examination is also an absolute sign of pregnancy and, unlike the foetal heart sounds and foetal movements, this absolute sign will still be present if the foetus is dead.

A general description of the signs and investigations during pregnancy will first be given, and then the chronological order of their appearance can be summarized.

Signs due to Changes in the Uterus.—The earliest alteration in the uterus that can be detected as a rule is slight *enlargement of the body of the uterus*. This sign is of little value in the case of a patient who has been pregnant before, but it may be significant in a first pregnancy. The body soon becomes globular, and as progressive enlargement occurs the diagnosis becomes more evident.

Softening of the uterus, due to increased vascularity, is a helpful sign, for although there are many other causes for enlargement of the uterus they do not as a rule lead to softening. The softening may

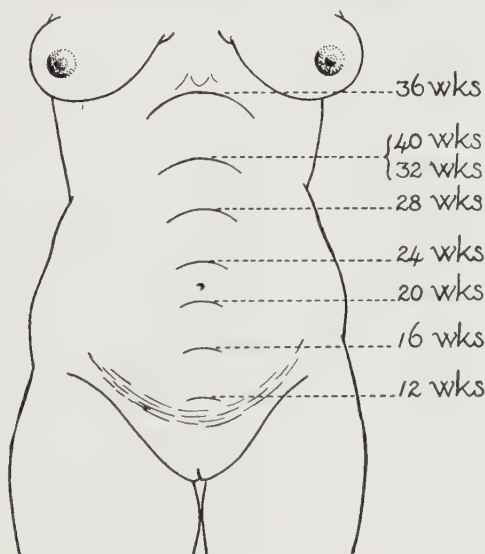


FIG. 18.—HEIGHT OF FUNDUS.

follow a certain pattern. The isthmus of the uterus (the lowest part of the body) softens first, and until about the 9th week on bimanual examination the globular fundus may feel quite distinct from the still unsoftened cervix. Formerly, *Hegar's sign* was elicited by firm bimanual palpation at this stage, when the soft and empty isthmus was compressed, so that the examiner had the impression that the cervix and body of the uterus were separate, but attempts to elicit this sign should never be made, as they may well cause a miscarriage.

Softening and blue discoloration of the cervix soon follow, and are usually complete by the 16th week. When these changes are well

marked they are fairly reliable signs of pregnancy, but softening does not invariably occur, and the cervix sometimes remains firm throughout pregnancy.

By the 12th week the uterus is usually palpable in the abdomen just above the symphysis pubis, and *progressive enlargement* then occurs (see Fig. 18). The fundus reaches the level of the umbilicus at about the 22nd week, and is just below the ensiform cartilage at the 36th week. If the presenting part of the foetus then sinks into the pelvis the fundus descends slightly, so that at full time it is again at the level that it occupied at the 34th week. The level of the fundus may be higher than expected from the duration of pregnancy with multiple pregnancy or with hydramnios, and at a lower level than expected with an abnormal, dead or ill-developed foetus.

The pregnant uterus varies in consistence on palpation because it undergoes *painless contractions*. If the patient is easy to examine this variation in consistence may be noticed even when the uterus is still a pelvic organ. When the uterus rises up into the abdomen the contractions are more easily felt, and are very reliable evidence that any swelling under examination is in fact the uterus.

Because the blood flow through the vessels in the broad ligament is greatly increased during pregnancy, on auscultation with a stethoscope pressed firmly against the side of the uterus the *uterine souffle* may be heard. This can be detected at any time after the 16th week, but cannot invariably be demonstrated. It is a blowing murmur, synchronous with the maternal pulse. It is not diagnostic of pregnancy, as it may also be heard in some cases of large uterine fibromyomata.

Signs due to the Presence of the Foetus.—From the end of the 16th week until about the 30th week the sign known as *ballotement* may be elicited. It depends upon the fact that during this phase of pregnancy the foetus is floating in a relatively large amount of liquor amnii. It may be elicited by vaginal examination, when it is spoken of as internal ballottement, or by abdominal examination, when it is called external ballottement.

Internal ballottement is felt by placing a finger in the vagina with the patient on her back, when the foetal head is felt through the anterior fornix. It is then pushed upward with a jerking movement, and can then be felt to float away and then fall back on the finger with a distinct tap.

External ballottement is elicited by placing the patient on her side. One hand is placed under the abdomen and the other above it. The lower hand then jerks the foetus upwards and recognizes the impact as it falls back. Neither method of ballottement should be employed with any vigour for fear of causing placental separation.

In late pregnancy the foetal head may be ballotted during the abdominal examination of a case of breech presentation, when the head can be felt to move between two hands at the sides of the fundus.

Abdominal *palpation of foetal parts* is usually possible from the 24th week onwards, and at a later stage the definite recognition of such structures as the head, back and limbs of the foetus is an absolute diagnostic sign of pregnancy.

During palpation the *foetal movements* may be felt, and this too is an absolute sign. Not only may the movements be felt, but they can sometimes be seen if the patient is not too fat.

On auscultation of the abdomen the *foetal heart sounds* may be heard at some stage after the 24th week. The foetal heart rate varies between 120 and 160 beats per minute, and is therefore at roughly double the rate of the maternal beat. The sounds are said to resemble the ticking of a watch under a pillow; there is a double sound to each beat, but the sounds are softer and of a different pitch from the maternal sounds. The sounds are most easily heard with a stethoscope with a wide bell.

Before the 30th week the foetal heart is most often heard in the centre of the abdomen near the fundus. In the later months in vertex presentations it is best heard about one-third of the distance along a line from the umbilicus to the anterior superior spine of the ilium. In breech presentations it is heard at the level of or just above the umbilicus on the upward prolongation of this line on either side.

The *funic souffle* is occasionally heard when the stethoscope happens to lie directly over the umbilical cord, and is a soft blowing murmur, synchronous with the foetal heart.

Signs due to Changes in the Breasts and the Skin.—The changes in the breasts in pregnancy have already been described (see p. 49) but may be summarized here. The earliest sign is due to proliferation of the peripheral lobules of the breast, which may give rise to a knotty feeling at the edge of the gland. Pigmentation of the areola of the nipple occurs before the 8th week, but may be very slight in fair women. This *primary areola* persists after the first pregnancy, so that the sign is useless in the diagnosis of any subsequent pregnancy. The sebaceous glands around the areola become enlarged to form a ring of small tubercles (*Montgomery's tubercles*), and the subcutaneous veins over the breast become dilated, but these changes are not always sufficiently clear-cut to be diagnostic.

By the 12th week a clear secretion can usually be expressed from the nipple, but this sign too is only of value in a first pregnancy, as secretion can often be expressed from the breast of any patient who has once been pregnant, even when she is not again pregnant.

In a second or subsequent pregnancy only one change in the breast is absolutely diagnostic, and that is the appearance of the *secondary areola*, which is a patchy pigmentation of the skin outside the primary areola. This only occurs in dark-skinned women, and after the 20th week of pregnancy. It fades during the puerperium.

The appearance of *striae on the abdomen* and the *linea nigra* have already been described (see p. 50), but these are also only helpful in the diagnosis of a first pregnancy, as they tend to persist afterwards. In a subsequent pregnancy *striae* in the abdomen may become freshly pigmented.

RADIOLOGICAL DIAGNOSIS OF PREGNANCY

The demonstration of foetal bones in an X-ray photograph is a certain method of diagnosing pregnancy. With a good plate, and a patient who is not too fat, a positive result may be expected from the 16th week onwards. It is, however, undesirable to use this method in early or mid-pregnancy, when it is thought that the foetus is particularly susceptible to the effects of radiation.

BIOLOGICAL TESTS FOR PREGNANCY

These tests depend on the fact that during pregnancy the trophoblast of the embryo secretes large quantities of gonadotropic hormone, and that this chorionic gonadotropin is excreted in the maternal urine. If some of the urine is injected into one of various species of animals specific changes are produced in the gonads by the chorionic gonadotropin it contains. The most certain results are obtained if the urine is concentrated, and for that reason the patient is instructed to bring the first morning specimen after having restricted her fluid intake from the previous evening. A catheter specimen of urine is not necessary, but the urine must not be grossly infected.

The original test was that of Aschheim and Zondek, in which the urine was injected into immature female mice. If the urine contained sufficient gonadotropin to give a positive test the ovaries of the mice were found to contain numerous hæmorrhagic corpora lutea after 100 hours. This method can be used as a qualitative test by using various dilutions of the urine, and is used in this way in the diagnosis of hydatidiform mole (see p. 247).

The Friedman test depends on the stimulation of ovulation in the ovaries of rabbits.

Tests now in more general use are the Hogben test, in which the injection of urine containing chorionic gonadotropin into female *Xenopus* toads

causes the extrusion of ova within 15 hours, and the Mainini test, in which the injection into male toads (*Bufo Bufo*) causes the extrusion of spermatozoa within 6 hours.

The biological tests are particularly useful during the first 12 weeks of pregnancy when the excretion of chorionic gonadotropin is high, and when the clinical diagnosis may be difficult. During this stage of pregnancy a positive result is nearly always reliable, but occasionally negative results are incorrect, especially if they are performed before the 6th week of pregnancy. The amount of gonadotropin excreted after the 12th week falls off, and for that reason the tests are less reliable at that stage.

A point that should be mentioned is that a weak positive result is sometimes obtained just after the menopause because of the high level of *pituitary* gonadotropin at that time, and unless strongly positive the test should be accepted with reserve in the investigation of amenorrhœa at the age of the menopause.

CHRONOLOGICAL SUMMARY OF THE SIGNS AND SYMPTOMS OF PREGNANCY

5th–8th weeks.—Amenorrhœa, discomfort in breasts, enlargement of the uterus, morning sickness, commencing pigmentation of the areola. Pregnancy tests positive.

9th–12th weeks.—Amenorrhœa, morning sickness, frequency of micturition, uterus just palpable per abdomen, pigmentation of the areola, secretion can be expressed from breasts, softening of cervix, coloration of cervix and vagina. Pregnancy tests positive.

13th–16th weeks.—Amenorrhœa, morning sickness ceasing, uterus halfway between pubes and umbilicus, pigmentation of areola, Montgomery's tubercles, uterine souffle, internal ballottement, softening of the cervix, coloration of the vagina. X-ray shows foetal bones.

19th–20th weeks.—All the signs and symptoms mentioned for previous month; also quickening, the secondary areola if present, uterine contractions, uterus nearly to umbilicus.

21st–24th weeks.—All the above, uterus just above the umbilicus, striae, linea nigra.

25th–28th weeks.—Uterus reaches one-third of the distance between the umbilicus and the ensiform cartilage. All the positive signs, foetal heart, foetal movements, uterine contractions.

29th–32nd weeks.—Uterus reaches almost to the ensiform cartilage.

33rd–36th weeks.—Uterus reaches the ensiform cartilage.

After 36th week.—Uterus sinks again to about the position it had reached at the 34th week, foetal head engaged in primigravidae.

THE DIAGNOSIS OF PREGNANCY

Certain of the signs of pregnancy are absolute, namely, hearing the foetal heart-sounds, the manual appreciation of foetal parts and movement and radiological demonstration of foetal bones. Detection of any one of these makes the diagnosis of pregnancy certain. Since, however, the first signs only occur with a live foetus, the X-ray affords the only sign that is absolute under all conditions. Nevertheless, radiological diagnosis is undesirable because of the possible adverse effect of radiation on the foetus.

Certain other of the signs though not absolute are very strongly presumptive, namely, a positive result of the biological pregnancy test. The pregnancy test is of practical usefulness from the 7th week, but taking positive and negative results together there is an error of about 1 per cent.

Uterine enlargement corresponding to the period of amenorrhœa during the period of reproductive life is strongly presumptive of pregnancy, since practically all the enlargements of the uterus during this period are accompanied by increased menstrual loss, or at least, no diminution of it. This syndrome is available for diagnosis from the 8th week onwards, and when its significance is reinforced by a positive result to the pregnancy test, it may be taken as an absolute indication of pregnancy.

In some pregnant women the size of the uterus and the period of amenorrhœa do not correspond, since conception may take place during a period of amenorrhœa, or intra-uterine death may occur and amenorrhœa persist. In such patients the uterus will be smaller than the duration of amenorrhœa suggests. Conversely, the uterus will be larger than the period of amenorrhœa suggests when bleeding, which is mistaken for menstruation, has occurred after conception. Other causes of the excessive enlargement of the pregnant uterus are, multiple pregnancy, hydramnios, vesicular mole and the presence of a fibroid in addition to the pregnancy.

The remaining signs of pregnancy are suggestive only. A uterine souffle may be heard occasionally over fibroids; ballottement may be simulated by tumours when, in addition, there is free fluid in the peritoneal cavity; softening of the cervix and coloration in the vagina occur under other conditions.

It follows, therefore, that none of these signs, even taken in conjunction, warrant a certain diagnosis of pregnancy, and their presence should be regarded only as an indication to ascertain whether the absolute signs of pregnancy do or do not exist as well.

THE DIFFERENTIAL DIAGNOSIS OF PREGNANCY

The enlargement of the uterus caused by pregnancy has to be differentiated from other conditions producing an abdomino-pelvic swelling, of which the commonest are ovarian cysts, fibroids and a distended bladder. Pregnancy also may be associated with these swellings.

Ovarian Cysts.—In many cases the uterus of normal size can be palpated bimanually separate from the swelling. The pregnancy test is negative and none of the absolute signs of pregnancy is present. Ovarian neoplasms are only accompanied by amenorrhœa during the reproductive period if they are bilateral and totally destroy the ovaries. A thrill or fluctuation is common with ovarian cysts but is only felt in the pregnant uterus in cases of hydramnios.

Uterine Fibromyomata.—These tumours when deeply placed in the uterus enlarge it symmetrically as pregnancy does and, though as a rule they are much harder, they are sometimes soft enough to simulate the consistence of the pregnant organ. They are, however, hardly ever associated with amenorrhœa and in most cases are accompanied by severe and increasing bleeding at each monthly period. The pregnancy tests are negative and none of the absolute signs of pregnancy is present.

Distended Bladder.—The bladder may become enormously distended if there is retention due to a retroverted incarcerated gravid uterus (p. 213). The passage of a catheter will disclose the nature of the swelling.

Pregnancy Associated with an Ovarian Cyst.—Two swellings will be present, the pregnant uterus, presenting its usual characters, and the cyst. The signs of pregnancy will be present in accordance with the duration of the pregnancy, but before the foetal heart and parts can be detected there may be some difficulty in deciding which of the two swellings is the uterus. In some cases they are in such close juxtaposition that it is not easy to distinguish two separate swellings. An X-ray examination may sometimes be justifiable in such cases. A cyst lying in the pelvis propping up the pregnant uterus in front of it may be mistaken for the uterus, and the real uterus for a distended bladder, but the passage of a catheter will immediately correct the mistake.

Pregnancy Associated with Fibromyomata.—If the fibroids are small they can easily be mistaken for foetal parts. A fibroid in the uterine wall is immobile, unlike a foetal limb which may be felt to alter its position from time to time. Where there is one large abdominal fibroid, it presents as a much harder part of the abdominal swelling over which none of the uterine signs of pregnancy can be elicited, in contrast with the softer part of the swelling where the pregnancy lies. The fibroid may be in the pelvis with the pregnant uterus above it and may even be mistaken for the child's head.

Occasionally a fibroid in the pelvis below the pregnancy may obstruct the bladder so that it becomes greatly distended. A catheter should be passed in all cases in which the diagnosis is in doubt. Early pregnancy is difficult to diagnose in the presence of these tumours and the biological pregnancy tests are of the greatest value.

PSEUDOCYESIS

Pseudocyesis, or spurious pregnancy, is a psychological disorder in which the woman has the false but fixed belief that she is pregnant. The term does not include the uncommon instances of wilful and conscious deception; the patient honestly believes that she is pregnant.

Pregnancy fantasies may occur in gross psychoses, usually cases of schizophrenia, but the more common case of pseudocyesis is not associated with such severe mental illness, but is rather an instance of hysteria.

It is frequently, but not invariably, seen near or after the menopause, and not always in women without children. There may be amenorrhœa, and the patient will declare that she has morning sickness and breast enlargement, and that she can feel foetal movements. The abdomen may appear distended, either by gas collected in the stomach by ærophagy, by intestinal distension, by persistent contraction of the diaphragm, or sometimes just by fat. Breast tenderness is sometimes due to chronic mastitis.

The shape of the swelling is not that of the pregnant uterus, and foetal parts cannot be felt nor the foetal heart heard. In cases of gross obesity a biological pregnancy test or even an X-ray may be justified. The difficulty is to convince the patient of the truth.

ESTIMATION OF THE EXPECTED DATE OF DELIVERY

Since there is no definite means of knowing the time at which conception occurs, it is usual and convenient to calculate the date on which delivery is to be expected from the first day of the last menstrual

period. A simple practical method is to count forward 9 calendar months (or backward 3 calendar months) from the first day of the last period, and to add 9 days. This gives an average of 282 days, with a little variation as the lengths of the calendar months are not uniform. If the previous menstrual cycles were irregular or prolonged no reliance can be put on this method. Even if the previous cycles were regular, in as many as 40 per cent. of cases labour begins more than 7 days before or after the calculated date.

An attempt has often to be made to estimate the probable date of delivery when the date of the last menstrual period has been forgotten, or when conception occurred during a phase of amenorrhœa, for example during lactation. In such cases the observed height of the fundus, especially if repeated observations are available, is the best guide. The date at which the patient first felt foetal movements (quickening) may also give a rough indication of maturity. Primigravidæ usually feel movements of the foetus at between 18 and 20 weeks, and multiparæ may recognize the movements a little sooner, but a patient who cannot remember the date of her last period is seldom able to give an accurate report of the date of quickening.

POSTMATURITY

Postmaturity means the prolongation of pregnancy beyond its normal duration, but there is no generally accepted definition or any agreed limit to the duration that can be regarded as normal. The difficulty in making any definition is that the precise date of conception in any particular pregnancy is unknown; even with regular menstrual cycles of normal length the date of ovulation is only approximately known. In cases with irregular or prolonged cycles calculations based on the date of the last menstrual period are bound to be inaccurate.

Apart from the uncertainty of the date of ovulation, it is inherently unlikely that all foetuses will mature in precisely the same number of days. The cause of the onset of labour at term is also unknown. In animals pregnancy can certainly be prolonged by giving large quantities of progesterone, but there is no evidence that delay in the onset of labour in women is due to this or any other hormonal abnormality.

Diagnosis.—General statistical statements based on large numbers of cases can easily be made, showing that about 25 per cent. of cases of pregnancy will be delivered during the 42nd week, 12 per cent. during the 43rd week, 3 per cent. during the 44th week, and half of 1 per cent. more than 44 weeks after the beginning of the last period, but in any particular pregnancy the diagnosis of postmaturity is usually uncertain.

Only in cases in which the date of the last menstrual period is certain, and in which the previous cycles were of normal length, can the diagnosis be reasonably made. In other cases the evidence is usually too unreliable to justify any action being taken. Observations of the height of the fundus during pregnancy, or of the date of quickening, are not accurate enough to allow of precise estimation of maturity. Not only is it difficult to assess the size of the foetus in the uterus, but even in normal cases the weight may vary between about $5\frac{1}{2}$ and 10 pounds at term, so that estimates based on the size of the foetus are also unreliable. The dates of appearance of the ossific centres vary widely. On the whole an accurate and certain menstrual history remains the most reliable guide.

Clinical Significance.—The delayed onset of labour might, in theory, have two disadvantages: (1) The placental function may become inadequate after term, as the uterine blood flow diminishes (see p. 37), and degenerative changes progress. (2) There may be mechanical difficulties during labour due to the increased size of the foetus, and perhaps the uterus which is slow to begin labour may also prove inefficient during labour.

The risk of the foetus dying in the uterus from anoxia before the onset of labour in postmature cases has probably been exaggerated, though this does occasionally occur. There is, however, good evidence that the risk of foetal distress and stillbirth during labour is greater in postmature than in normal cases. In part this is due to more difficult labour, due to the larger size of the foetus and to inco-ordinate uterine action. The skull of the postmature foetus is more ossified, and therefore harder, so that moulding is less easy.

Many obstetricians consider that the risk of anoxia in postmature cases is increased if there is also hypertension, and in the case of an elderly primigravida.

Medico-legal Significance.—Postmaturity may be of great medico-legal importance, as a husband may question the paternity of a child born more than 44 weeks after he left his wife. In law each case is decided on the basis of the medical evidence, and there is no legal definition nor set upper limit for the normal duration of pregnancy. In a recent case a child born 346 days after the last cohabitation was judged to be legitimate, but in another case a child born after 360 days was adjudged illegitimate on appeal.

Management.—Postmaturity is often a cause of worry, and sometimes of expense and inconvenience, to the mother, and pressure is often put upon the obstetrician to induce labour. While this may be justifiable in some cases in which the menstrual history is certain, it is most unwise with an uncertain history, when there is a risk that the

foetus may, after induction, prove to be premature rather than postmature.

Since patients and their relatives tend to worry when the date given to them as the expected date of delivery has been passed, it is most desirable that every patient should be told that the calculated date is only an approximation, and that normal labour often starts a week or more later than this date.

Each case of suspected postmaturity must be dealt with according to its special circumstances. There is no justification for making a rule to induce all cases at some stated week of pregnancy ; the risks of indiscriminate induction might well exceed those of postmaturity. If the menstrual cycles were irregular or long, or if the date of the last period is uncertain, as the clinical diagnosis of postmaturity is so unreliable there is little justification for any interference.

In other cases, especially those with hypertension, or in those occurring in elderly primigravidæ induction may be considered. Induction may also be recommended for a patient with a foetus that is evidently large, and in whom there is increasing risk of disproportion as the foetus continues to grow. There can be little justification for induction until the patient is at least a fortnight overdue, except in cases with hypertension.

Labour may be induced in cases of postmaturity by three methods, which are often combined :

- (1) Reflex stimulation of the uterus by giving an enema and a hot bath.

- (2) The use of pitocin, either intramuscularly or intravenously.

- (3) Artificial rupture of the membranes. The first method is innocuous, but of doubtful efficacy. Pitocin used to be given by intramuscular injections of 2 units at half hourly intervals for 6 doses, but the absorption of the pitocin by this route is erratic. The more effective method is to give the pitocin by slow intravenous infusion (see p. 597), but this method requires most careful supervision with frequent observations of the foetal heart-rate and the strength of the uterine contractions, which would be difficult except in hospital. It may also be used before artificial rupture of the membranes, especially in cases in which the cervix seems to be firm and resistant, and it may sometimes be used if labour does not start after the membranes have been ruptured.

On the whole, if it is decided to induce labour for postmaturity it is best to rupture the membranes forthwith. Other methods are less certain, and if they fail the patient's anxiety may be much increased.

In any case of suspected postmaturity the careful supervision of the labour is probably more important than the decision whether or not to

induce labour. A vigilant watch is kept for any sign of foetal distress, such as any change in the foetal heart rate or the passage of meconium into the liquor. In the few cases in which foetal distress occurs immediate delivery must be effected, either by forceps delivery if the cervix is fully dilated, or otherwise by Cæsarean section. It must be remembered that the foetus is large, and disproportion is a possibility, making any manipulation such as rotation of an occipito-posterior presentation more difficult.

OTHER CONDITIONS OF MEDICO-LEGAL IMPORTANCE

The Effects of a Recent Pregnancy.—It is sometimes of importance to be able to recognize the effects of a past pregnancy from a medico-legal point of view. The signs of a recent delivery are always clear, but those of an abortion may not be, and further, a full-time delivery leaves marks on the patient which are indelible for all time, while an abortion may not leave any sign.

The signs of a recent delivery, say within a week or two, are general and local. The breasts will be full and contain milk, and may show striæ. The abdominal wall is usually lax, the skin pigmented and striæ gravidarum are present. The uterus will be enlarged, the size depending upon the time which has elapsed since delivery. The cervix will be soft, somewhat patulous and possibly lacerated. The vaginal walls will be relaxed and inspection may reveal minute tears. The hymen will show deep lacerations through its whole thickness, the remnants being swollen and congested in primiparæ. The fourchette will be torn through in a vertical direction as a rule, and there may be more or less laceration of the perineum and lower part of the vagina. The presence of these lacerations is the most convincing of all evidence that a recent full-time delivery has occurred. The discharge from the external os will be more or less blood-stained according to the degree of involution which has occurred.

It is much more difficult to say with any degree of certainty that abortion has recently occurred. Even at the end of a week after an early abortion very few signs may be found, locally or generally, which could be sworn to as evidence of a recent pregnancy. It is improbable that any laceration or injury of cervix, vagina or vulva would be discovered. The discharge may have ceased, and the pelvic organs may not be congested; but there is usually a lochial discharge for a week or 10 days. The uterus would certainly be enlarged, but it is impossible to say definitely that a slight enlargement of the uterus is due to a recent abortion. It might have been due to a long-past pregnancy. So that unless the patient was seen and examined within

a day or two of an early abortion, it is hardly likely that any positive signs would be present. The biological tests for pregnancy remain positive for a variable time after the death of an ovum. In nearly all cases the tests become negative in 48 hours but they may remain positive for a longer period if a piece of living chorion remains attached to the wall of the uterus.

Signs of a Long-Past Pregnancy and Delivery near Full Time.—*Striæ gravidarum* will probably be seen on the abdomen; occasionally, however, they are absent. Also these marks may occasionally be the result of other conditions such as Cushing's syndrome.

The uterus is usually larger than that of a nulliparous woman, but the amount of enlargement is slight. The *os uteri* is nearly always altered in shape, instead of a circular or oval opening it is a transverse slit. It may show notches, unilateral, bilateral or starred, the result of laceration. It must be remembered that notches in the cervix may be the result of former surgical treatment, but they are small compared with the laceration caused by labour. The vaginal walls are relaxed and the calibre of the canal enlarged. The hymen has disappeared leaving small protuberances, the *carunculæ myrtiliformes*. Coitus, apart from delivery, injures the hymen, but the lacerations made by it are superficial and do not completely break it up. The *fourchette* is always torn in a full-time delivery, and the *fossa navicularis* is flattened out, ceasing to exist as a distinct hollow. A scar in the perineum and general relaxation of the vaginal outlet are very suggestive signs of delivery.

Signs of Virginity.—It sometimes happens that an opinion has to be given as to the virginity of a woman. It may be a matter of extreme simplicity or may be impossible to decide. For instance, if on vulval examination it is seen that the hymen is absolutely intact, that it only admits the finger-tip, and has a sharp edge which firmly encircles the finger, it is clear that no penetration of anything larger than the finger-tip can have occurred, and a definite opinion can be given that the patient is *virgo intacta*. If, however, the hymen easily admits one or two fingers, this is not proof that sexual connexion has occurred. If the hymen is notched in several places, is lax and dilated, and one or two fingers pass in easily without the patient's flinching, or experiencing pain, it is possible that coitus has occurred but by no means certain, for the effect of the prolonged use of vaginal tampons for menstrual hygiene is the same.

It must be remembered also that the hymen may be dilated and even notched in this way merely by the passage of a finger during

an examination, or that the patient may have had an operation or examination in which a speculum was used, and that even the constant passage of a douche nozzle may produce the same effect. All that can be said, therefore, in such a case is that something has been passed through the hymen sufficient to stretch or notch it, but it does not follow that these appearances are the result of sexual connexion.

The signs of a recent first coitus may be more positive. There may be unhealed lacerations of the hymen, the orifice may be reddened and swollen, and may also be acutely sensitive. In the case of a recent attempt at rape, it is usual to look for the presence of spermatozoa in the vagina, or on the clothing of the woman or child. A dried stain on a garment may show the presence of spermatozoa when examined by proper methods. The suspected material is extracted for some hours in a minimal quantity of normal saline. The extract is dried on a slide and stained with hæmatoxylin and eosin which stain the spermatozoa and their heads blue and red. Specific precipitin reactions are also recognized.

CHAPTER VIII

THE PELVIS

THE pelvis of an infant is small, even in proportion to the size of the child ; it has an almost straight sacrum united to an almost straight spine at a slight angle (the sacro-vertebral angle), hence the promontory is not well marked, and is placed at a higher level than in an adult pelvis. The anterior surface of the sacrum is flat from above downward and also from side to side ; it is narrow, because the lateral

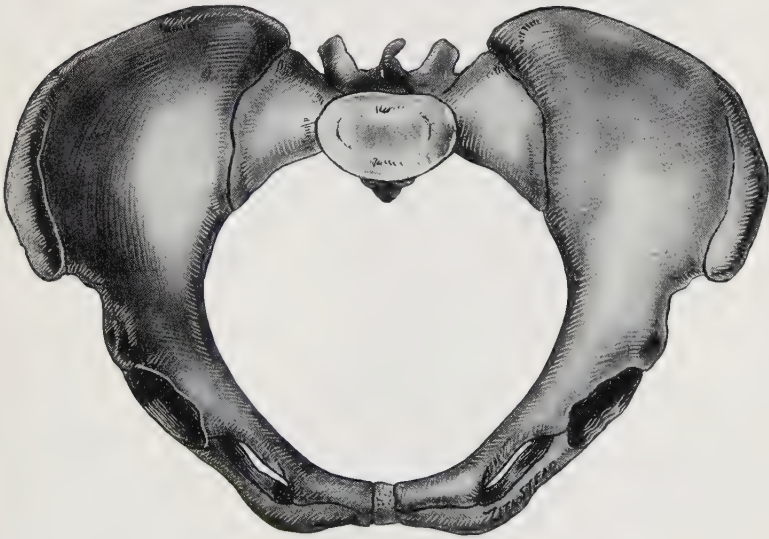


FIG. 19.—THE GYNÆCOID PELVIS SHOWING THE BRIM.

masses are poorly developed. The iliac fossæ are shallow and look inwards. This infantile pelvis becomes altered by,

1. The growth of the bones.
2. The body-weight acting through the sacrum and resisted by the pressure of the femora on the acetabula.
3. Muscular action and the tension of ligaments.

It may be noted that the 2nd and 3rd causes act equally in the male and in the female and, therefore, the characteristics of a female pelvis must be due to an inherent tendency on the part of the bones to develop along certain definite lines.

However, radiological investigations have shown that variations from the typical female pelvis are not uncommon, and these must not be considered as abnormal. What had been accepted as the normal female pelvis, the *gynecoid pelvis*, is now known to occur in only 41·4 per cent. of the white population. Of the others, some show marked male characters, the *android pelvis*; others resemble that of the anthropoid ape, the *anthropoid pelvis*; whereas in the remainder the pelvis is flattened and has been named the *platypelloid pelvis*. (See p. 404.)

Only the gynecoid pelvis will be described here (Fig. 19). In this pelvis the inlet is rounded, except for a slight projection of the sacral promontory, and may be divided into an anterior and posterior segment by a line drawn through the widest transverse diameter.



FIG. 20.—THE OS INNOMINATUM OF A GYNÆCOID PELVIS SHOWING THE WIDE SCIATIC NOTCH.

The posterior half of the inlet is deeper than in the male pelvis because of the increased width of the sacro-sciatic notch below it. The anterior half is also roomy because of the wide angle made by the diverging ilio-pectineal lines. Seen from the front, the gynecoid pelvis has a very wide and shallow sub-pubic angle, and the descending rami of the pubic bones are not so deep as in the male pelvis. The cavity is circular and large. A lateral view of the pelvis demonstrates the typically wide sacro-sciatic notch (Fig. 20). The sacrum is concave on the anterior surface and is inclined backwards. The

space between the lower lateral border of the sacrum and the spine of the ischium is very wide because of the general breadth of the sacro-sciatic notch. This gives roomy measurements in the cavity and makes the sacro-spinous ligament long.

The outlet is diamond-shaped. The wide sub-pubic angle produces a comparatively large transverse diameter between the two ischial tuberosities. The longest diameter is the antero-posterior and this may be increased by half an inch if the coccyx is movable.



FIG. 21.—THE GYNECOID PELVIS. ANTERIOR VIEW.

(Note the wide sub-pubic arch.)

Many small variations in form and size may occur in the gynecoid pelvis, but the general architecture remains the same.

The following account is concerned with the pelvis from an obstetrical point of view, and only those anatomical points which have relation thereto will be dealt with.

THE PELVIS AS A WHOLE

For obstetrical purposes the pelvis is divided by the brim into two parts, the false and true pelvis.

The False Pelvis is that portion above the brim. It does not take any part in the mechanism of labour, and is of interest only from the fact that between certain of its parts, measurements may be taken to try to form a judgment of the size of the true pelvis, and, if this is smaller than normal, of the nature of its contraction. The information thus obtained is often inaccurate.

The True Pelvis, which includes the brim and that portion of the pelvis below it, is divided into the brim, the cavity, and the outlet.

The Brim.—The brim is formed in front by the upper margins of the pubic bones, at the sides by the ilio-pectineal lines, and behind by the anterior and upper margin of the sacrum.

The Cavity.—The cavity of the pelvis is irregular in shape, and is formed by the pubic bones in front, the anterior surface of the sacrum and coccyx behind, and the inner surfaces of the ischial and iliac bones at the sides.

The Outlet.—The outlet, which is more or less diamond-shaped, is formed in front by the inferior rami of the pubic and ischial bones, behind by the tip of the coccyx and the sacro-tuberous ligaments, and at the sides by the ischial tuberosities.

PLANES AND STRAITS OF THE PELVIS

The true pelvis may be divided into a series of imaginary planes. Two of them, named the plane of the brim and the plane of the outlet, are not strictly mathematical planes and are, therefore, often referred to as the superior and inferior straits.

The 4 planes are, in order from above down (see Fig. 22)—

- (1) The plane of the brim, the pelvic inlet or superior strait.
- (2) The plane of the cavity or plane of greatest pelvic dimensions.
- (3) The plane of least pelvic dimensions.
- (4) The plane of the outlet or inferior strait.

(1) *The plane of the brim* or superior strait is rounded with the projection forward of the sacral promontory posteriorly. Laterally it is bounded by the ilio-pectineal lines, in front by the upper margins of the horizontal rami of the pubes, and of the bodies of the pubic bones and symphysis pubis.

(2) *The plane of the cavity* or plane of greatest pelvic dimensions is limited in front by the middle of the bodies of the pubic bones and symphysis pubis, behind by the junction of the second and third pieces of the sacrum, and laterally it passes through the ischial bones, at the level of the middle of the acetabula.

(3) *The plane of least pelvic dimensions* extends through the lower margin of the symphysis pubis, the tip of the sacrum or sacro-coccygeal joint, and laterally through the ischial spines.

(4) *The plane of the outlet* or inferior strait is roughly diamond-shaped and is bounded anteriorly by the lower margin of the pubic

arch, posteriorly by the coccyx; laterally by the great sacrotuberous ligaments and ischial tuberosities.

This plane is subject to so much alteration by the movements of the coccyx, that only measurements of the transverse diameter between the ischial tuberosities have much value.

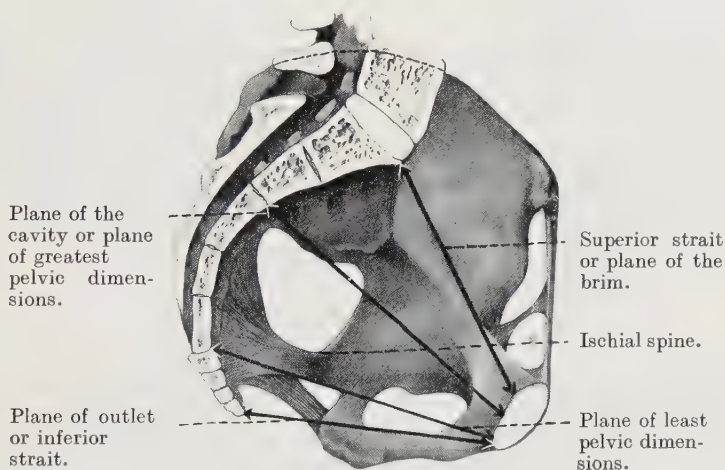


FIG. 22.—ANTERO-POSTERIOR SECTION OF THE PELVIS.

Showing the pelvic planes.

The plane of the brim is obstetrically the first in importance. But second only in importance is the plane of least dimensions, because it is at this level in small gynecoid (generally contracted) pelves and in pelves with a contracted outlet that obstruction is generally encountered. The measurement between the ischial spines is difficult and painful to take, but that from the sacro-coccygeal joint to the lower margin of the symphysis pubis is of practical value when combined with that between the inner margins of the ischial tuberosities and gives as good an estimate of the space available.

The Pelvic Floor.—The pelvic floor consists of the two levatores ani muscles. During the second stage of labour they form a musculo-fascial gutter, with the opening of the vagina looking forwards between the sides of the gutter. The pelvic floor plays an important part in directing forwards the most salient portion of the presenting part under the symphysis pubis. (For a full description of the anatomy of the pelvic floor the reader is referred to *Diseases of Women* by Ten Teachers, 10th Edition, Chapter III.)

The Sacro-iliac Joints are situated between the articular surfaces of the sacrum and ilium. During pregnancy these joints become softened and are capable of movement. By one of such movements the sacrum is able to rotate backwards or forwards through a transverse

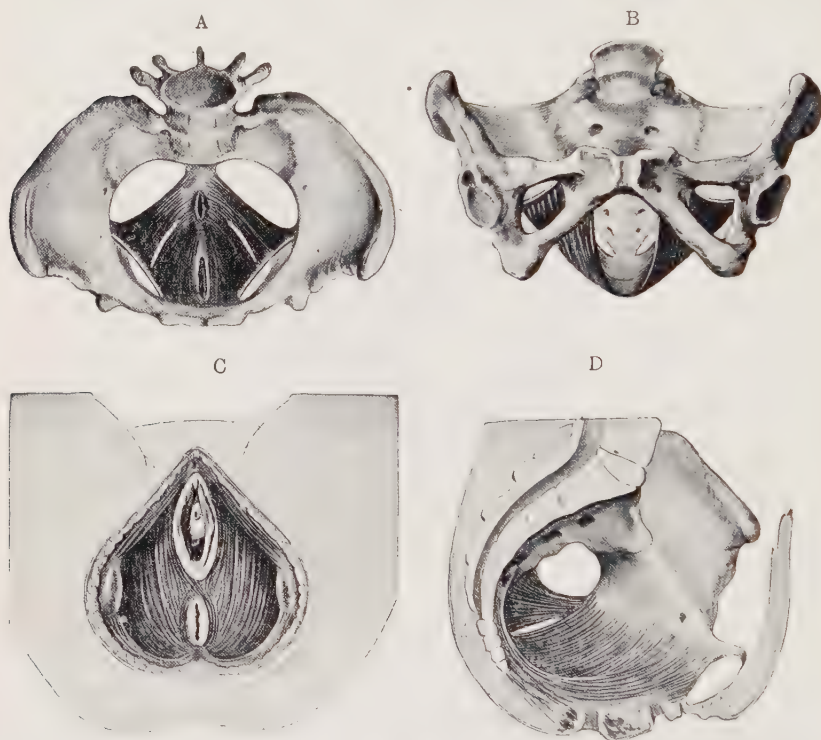


FIG. 23.

A, showing the pelvic floor muscles from above.

B, showing the gutter-like shape of the levatores ani.

C, showing the pelvic floor from below, perforated by the vagina in front and the rectum behind.

D, showing the pelvic floor in sagittal section as seen from the side, with the perineal body between the lower ends of the vagina and rectum.

axis passing through the centre of the joints, with the result that the size of the inlet or outlet of the true pelvis is diminished or increased accordingly. During the first stage of labour if a woman walks about, the pubes are swung away from the promontory, the size of the inlet of the pelvis being somewhat increased. During the second stage when lying down and flexing her thighs, the swing of the sacrum is reversed and the size of the pelvic outlet is increased. This excursion of the sacrum is more marked at its lower than its upper extremity.

The Pubic Joint.—The symphysis pubis is the joint between the upper and anterior portions of the bodies of the pubic bones. The softening of this joint facilitates the passage of the foetal head by allowing a widening of the pubic arch and the transverse diameter of the outlet.

The Sacro-coccygeal Joint.—This joint, becoming softened during pregnancy, allows the coccyx to be pushed backwards by the foetal head during its escape from the pelvis, thus enlarging the antero-posterior diameter of the outlet.

When there is ankylosis of the sacro-coccygeal joint, the coccyx has to be taken into account, as it then forms the posterior boundary of the obstetrical outlet.

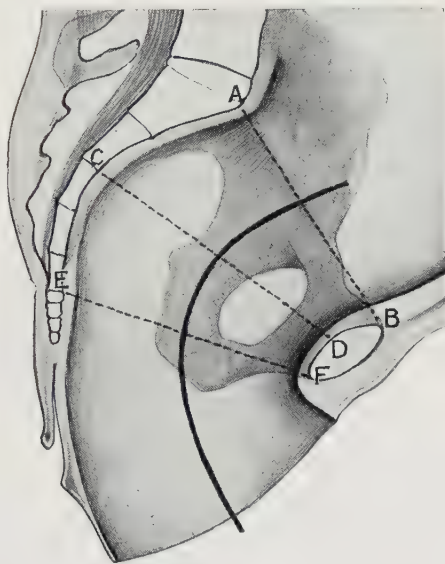


FIG. 24.—THE AXIS OF THE PELVIS.

The black line shows the position of the centre of the foetal head during its passage through the pelvis. This imaginary line is termed the axis of the pelvis.

A.B. Plane of Brim. C.D. Plane of Cavity. E.F. Plane of Outlet.

THE AXIS OF THE PELVIS

The axis of the pelvis consists of an imaginary line which would show the position of the centre of the foetal head in its passage through the pelvis. Such a line is obtained by taking any number of antero-posterior diameters of the true pelvis, between the plane of the brim and that of the outlet, when a line joining the centres of these diameters will indicate the axis of the pelvis (Fig. 24).

THE INCLINATION OF THE PELVIS

By the inclination of the pelvis is meant the relation of the plane of the pelvic brim to the horizontal. In the erect position the inclination of the pelvic brim forms an angle of 60 degrees with the horizontal.

Another way of measuring this is to take the angle between the plane of the inlet and the front of the body of the fifth lumbar vertebra (Fig. 25). The average angle obtained in this way is 135 degrees.

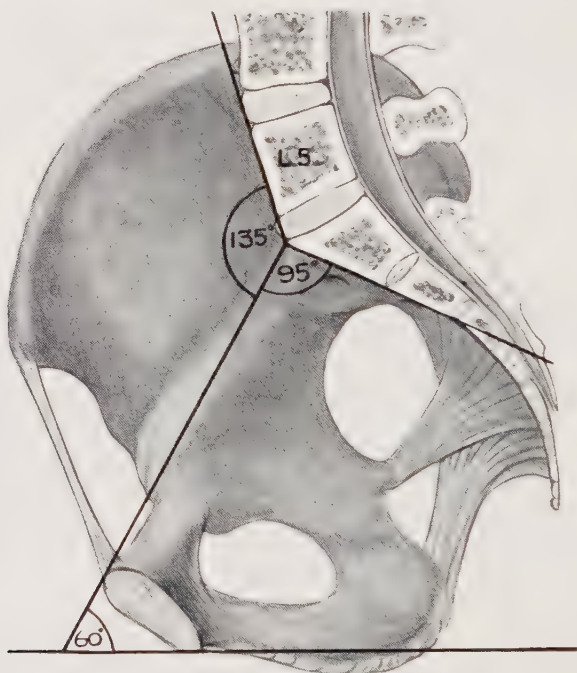


FIG. 25.

The angle of inclination of the pelvic brim is 135 degrees. The inclination of the sacrum is 95 degrees. The inclination of the pelvic brim to the horizontal is 60 degrees.

This is a more accurate method of measuring the inclination of the pelvic brim. The size and shape of the pelvis may be normal and there may not be any disproportion between the size of the foetal head and the brim, but failure of engagement of the head can occur solely because the inclination of the pelvic brim is abnormally high.

The shape, direction and inclination of the sacrum play an important part in providing the necessary space for engagement of the head

in the upper part of the true pelvis. The sacral inclination is measured by taking the angle between the first piece of the sacrum and the plane of the inlet (Fig. 25). This measures on an average 95 degrees.

CLINICAL EXAMINATION OF THE PELVIS

A pelvic examination is usually undertaken early in pregnancy, to confirm the diagnosis, to exclude abnormalities of the pelvic organs, and to assess the capacity of the bony pelvis. If the patient has miscarried previously, or has had a threatened miscarriage, it is wise to postpone any internal examination until the 16th week of pregnancy or even later, and a further pelvic examination is often necessary about the 36th week of pregnancy in cases of suspected disproportion. It must not be forgotten that the foetal head is the best pelvimeter.

In this chapter we are concerned only with the clinical assessment of the bony pelvis.

External Pelvimetry.

It is now generally recognized that the external pelvic measurements cannot give an accurate picture of the shape or size of the true pelvis, and the practice of taking them has been abandoned in most obstetric units. But in case they are still used by some obstetricians a list follows.

The Interspinous Diameter is measured from the tips of the anterior superior iliac spines (Fig. 26).

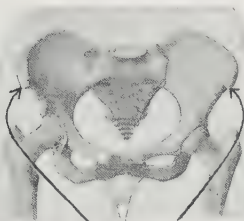


FIG. 26.
THE INTERSPINOUS DIAMETER.

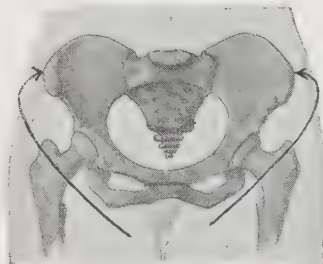


FIG. 27.
THE INTERCRISTAL DIAMETER.

The Intercristal Diameter is the distance between the most widely separated points on the outer margins of the iliac crests (Fig. 27).

The intercrystal diameter normally exceeds the interspinous diameter by 1 inch or more, but in a rachitic pelvis the difference between these two diameters may be less than 1 inch.

The External Conjugate Diameter is the distance between the tip of the fifth lumbar spine and the upper border of the anterior surface of the symphysis pubis (Fig. 28).

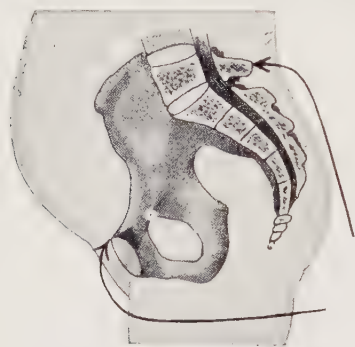


FIG. 28.

THE EXTERNAL CONJUGATE.

Showing the points on the skeleton between which the measurement is taken.

between the tuberosities, but of course there are considerable variations in the width of individual hands. An average measurement of the intertuberosity diameter is 8.75 cm. or $3\frac{1}{2}$ inches, but it must be appreciated that the widest transverse diameter of the outlet, normally 10.6 cm. or $4\frac{1}{4}$ inches lies, just behind the ischial tuberosities (Fig. 31).



FIG. 29.

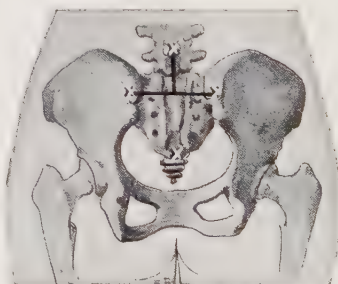


FIG. 30.

BACK VIEW OF A PATIENT, SHOWING THE "RHOMBOID OF MICHAELIS".

This is a diamond-shaped depression situated in the middle line immediately above the prominence of the buttocks. The crosses on the right-hand picture show the bony points corresponding to the four angles of the rhomboid. It will be seen that the upper half of the rhomboid is enclosed by lines joining the two posterior superior iliac spines with the spine of the 5th lumbar vertebra. These three points are often indicated by dimples in the skin, and are of use as a means of locating the 5th lumbar spine when measuring the external conjugate.

The Sub-pubic Angle between the descending pubic rami should be palpated with the thumbs of both hands pressed against the pubic rami. The angle normally measures slightly less than a right angle.

Measurements with a Tape Measure may be useful in cases of suspected pelvic obliquity. Tilting of the pelvis will be confirmed by measuring from the anterior superior iliac spine to the internal malleolus on each side. Tilting of the pelvis is only accompanied by asymmetry if the causative disease or injury occurred in early life. Tape measurements from the fifth lumbar spine to the symphysis, taken each side, will suggest true pelvic obliquity if they are unequal.

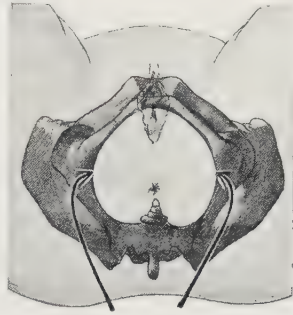


FIG. 31.

PELVIMETRY. MEASURING THE DISTANCE BETWEEN THE ISCHIAL TUBEROSITIES.

Internal Pelvimetry.

The Diagonal Conjugate is the distance between the promontory of the sacrum and the lower margin of the symphysis pubis. The sacral promontory cannot be felt in a normal pelvis unless the patient is anaesthetized. If it can be reached by the examining finger it is reasonable to conclude that the true conjugate diameter is considerably shorter than normal, and the case should be treated as one of potential disproportion (see Chap. XXXIII).

Assessment of the Pelvic Cavity is also undertaken by vaginal examination and is of much greater clinical value than external pelvimetry. A general idea of the capacity of the true pelvis can be formed and outstanding abnormalities noted. The anterior surface of the sacrum should be palpated from above downwards. In some cases the concavity is marked, and the lower part of the sacrum and coccyx may project forwards very considerably; in other cases the upper part of the sacrum may be straight or even slightly convex. The antero-posterior diameter of the cavity is the distance between the junction of the second and third sacral segments and the middle of the posterior surface of the symphysis, but it may be assessed clinically by measuring to the lower border of the symphysis as described for the diagonal conjugate.

Assessment of the Lower Pelvic Strait.—Measurement of the distance between the ischial tuberosities should only be taken as a rough estimate of the pelvic outlet, and a further assessment

of the lower pelvic strait should always be undertaken by vaginal examination.

The distance between the ischial spines, normally 10 cm. (4 inches), is difficult to measure clinically with any accuracy. The ischial spines should be found by sweeping a finger down the curve of the sacro-sciatic notch on each side, and with experience an impression may be formed as to whether the inter-ischial spinous diameter is normal or not.

The antero-posterior diameter of the outlet is measured from the sacro-coccygeal joint to the lower border of the symphysis pubis, as described for measurement of the diagonal conjugate, and the mobility of the coccyx should also be noted. If it is fixed this measurement should be taken from the tip of the coccyx. The antero-posterior diameter of the outlet normally measures 13.1 cm. or $5\frac{1}{4}$ inches, but the antero-posterior diameter available for the foetal head to emerge will be lessened if the sub-pubic arch is narrow.

X-ray Pelvimetry.

During the past twenty years various radiological techniques have been developed accurately to determine the measurements of the internal pelvic diameters and the measurements of the foetal skull.

Radiological assessment of the size of the pelvis and foetal skull necessitates several prolonged exposures to the X-rays which are now known to be inimical to the foetus. Moreover, it is open to doubt whether X-ray pelvimetry has changed a clinical opinion.

The modern treatment of suspected disproportion is by trial labour (see Chap. XXXIII).

CHAPTER IX

ANATOMY OF THE FŒTAL SKULL

A THOROUGH knowledge of the anatomy of the foetal skull is necessary before the mechanism of labour can be understood, for the size, shape and consistence of the skull all play a part in the mechanism of both normal and abnormal labour.

The foetal skull may be divided into the vault, face, and base. Calcification during intra-uterine life takes place more completely in the bones of the face and base than in the vault, and at birth they are firmly united to each other. The bones comprising the vault of the skull, however, are not so ossified, and when the child is born they are united only by thin unossified membranes. The result of this difference in development is that, while the bones of the base and face are incompressible, and so prevent damage to the vital centres in the medulla, which they surround, the vault is compressible, and thus allows of the size of the skull being diminished, and the shape altered, during its passage through the pelvis, by which means its expulsion is made much easier. This diminution in size is due to the fact that, by compression, the cerebro-spinal fluid and blood in the foetal brain are distributed to other parts of the body, while the change in shape, or moulding as it is termed, is brought about by the pliability of the bones of the vault and the presence of the membranes uniting them, which allow one bone to overlap the other. During the passage of the head, in a first vertex presentation for instance, the parietal bones overlap the frontal, occipital, and temporal bones, and the right parietal overlaps the left parietal bone.

Vault of the Foetal Skull.—The vault of the foetal skull consists of certain bones, sutures, and fontanelles.

Bones.—The bones of the foetal skull, which form the vault, are the 2 parietal and certain portions of the occipital, frontal, and temporal bones. At birth the frontal bone is divided into 2 equal parts.

Sutures.—The unossified membranes which unite the various bones of the vault are known as sutures. There are 6 of these sutures.

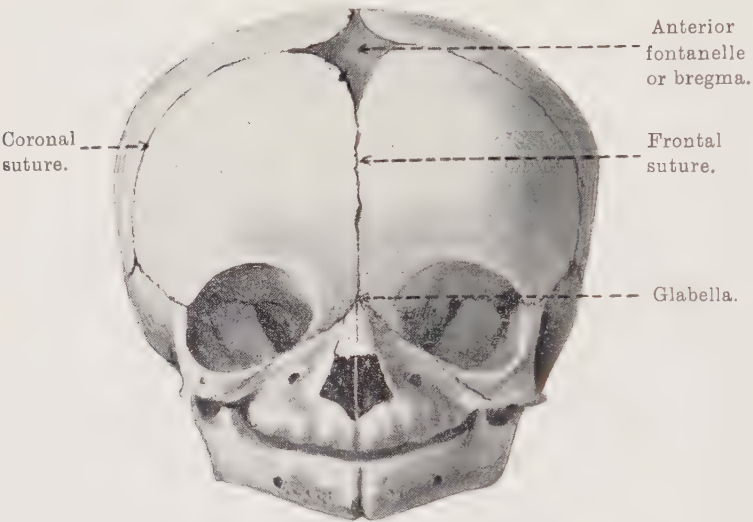


FIG. 32.—THE FŒTAL SKULL.

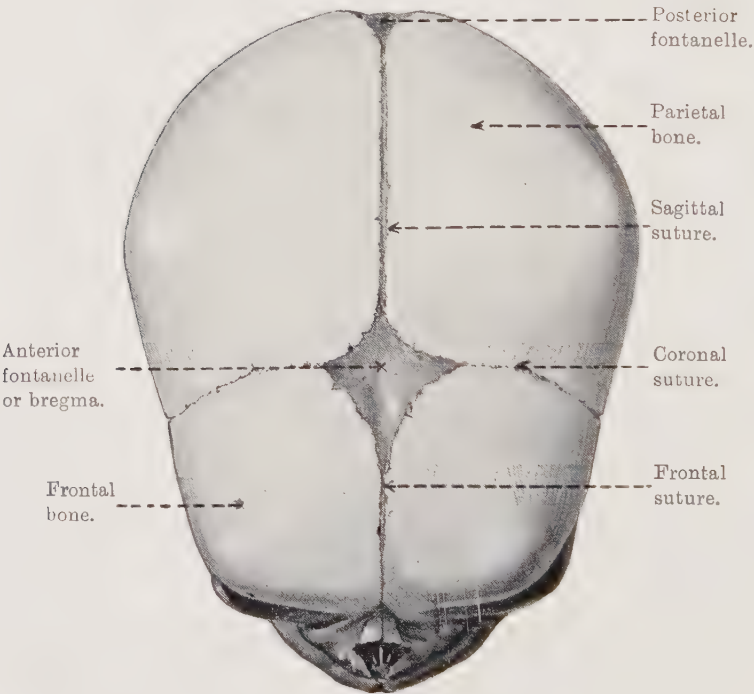


FIG. 33.—THE FŒTAL SKULL.

1. The sagittal suture, uniting the superior borders of the parietal bones.
2. The frontal suture, which is a continuation of the sagittal suture, uniting the 2 portions of the frontal bone.
3. The lambdoidal suture, uniting the posterior borders of the 2 parietal bones to the occipital bone.
4. The coronal suture, uniting the anterior borders of the parietal bones to the frontal bones.
- 5 and 6. The temporal sutures, uniting the squamous portion of the temporal bones to the inferior borders of the parietal bones.

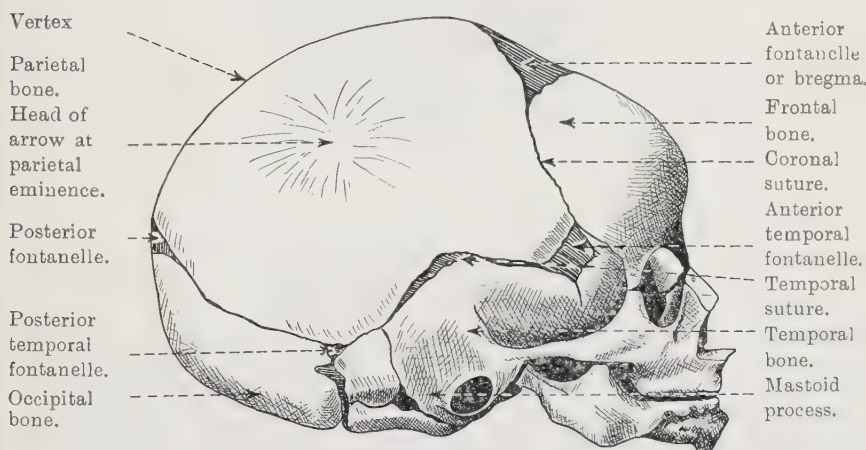


FIG. 34.—THE FŒTAL SKULL.

Lambdoidal suture between posterior fontanelle and posterior temporal fontanelle.

Fontanelles.—The points of junction of the various sutures are termed fontanelles, and they are 6 in number.

1. The anterior fontanelle, where the sagittal, frontal, and coronal sutures meet.
2. The posterior fontanelle, where the sagittal and lambdoidal sutures meet.
- 3 and 4. The anterior temporal fontanelles, at the junction of the temporal and coronal sutures.
- 5 and 6. The posterior temporal fontanelles, at the junction of the temporal and lambdoidal sutures.

Only the anterior and posterior fontanelles are of obstetrical importance. Their position when felt on vaginal examination

indicates in which direction the occiput is pointing, and the amount of flexion or extension present.

The anterior fontanelle or bregma can easily be felt unless obscured by a large caput succedaneum. It is much the larger of the two, is roughly lozenge-shaped, has 4 sutures running into it, is always patent at birth, and takes about 20 months to close.

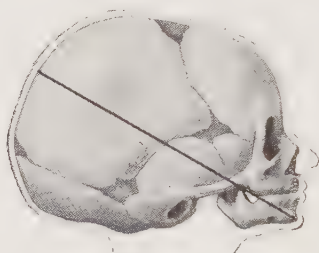


FIG. 35.

Mento-vertical diameter, $5\frac{1}{4}$ inches (13·1 centimetres).

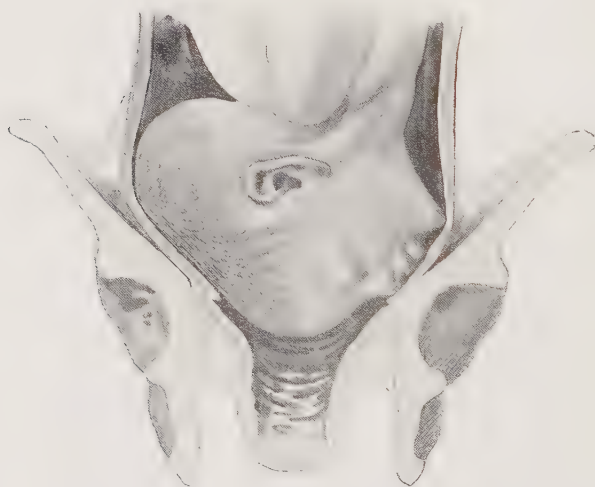


FIG. 36.

Showing the diameter, Fig. 35, thrown across the pelvis in a brow presentation.

The posterior fontanelle is triangular in shape, has 3 sutures running into it, in most cases cannot be felt as a space during labour, and closes soon after. The temporal fontanelles cannot be felt and are not, therefore, of assistance in diagnosing the position of the head.

DIAMETERS OF THE FETAL SKULL

The principal diameters of the skull concerned in the mechanism of labour may be divided into longitudinal, vertical and transverse.

Longitudinal Diameters.

Mento-vertical.—From the point of the chin to the farthest point on the vertex, which is nearer the posterior than the anterior fontanelle,

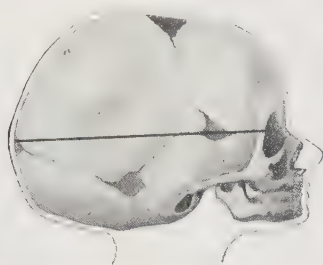


FIG. 37.

Occipito-frontal diameter, $4\frac{1}{2}$ inches (11.2 centimetres).



FIG. 38.



FIG. 39.

Showing the diameter, Fig. 37, thrown across the pelvis in an unreduced occipito-posterior position, and in incomplete flexion of the after-coming head.

$5\frac{1}{4}$ inches (13.1 cm.) (Fig. 35). This is the diameter thrown across the pelvis in a brow presentation, the head being midway between flexion and extension (Fig. 36).

Occipito-frontal.—From the root of the nose (glabella) to the posterior fontanelle, $4\frac{1}{2}$ inches (11.2 cm.) (Fig. 37). This is the diameter thrown across the pelvis in an un-reduced occipito-posterior position and in incomplete flexion of the after-coming head (Figs. 38 and 39).

Vertical Diameters.

Suboccipito-bregmatic.—From the junction of the head with the neck behind to the centre of the anterior fontanelle, $3\frac{3}{4}$ inches (9.3 cm.) (Fig. 40). This is the diameter thrown across the pelvis when the head is completely flexed (Fig. 41).

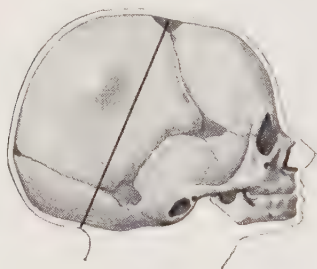


FIG. 40.

Suboccipito-bregmatic diameter, $3\frac{3}{4}$ inches (9.3 centimetres).

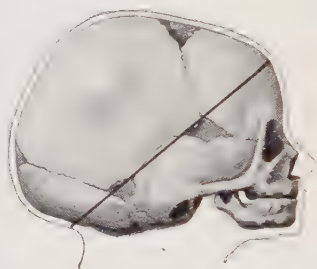


FIG. 42.

Suboccipito-frontal diameter, 4 inches (10 centimetres).

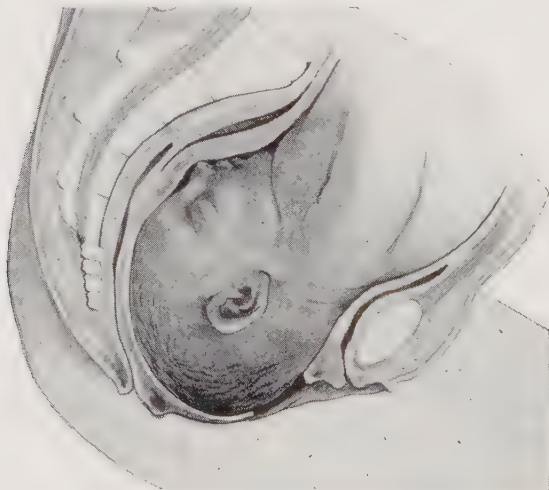


FIG. 41.

Showing the diameter, Fig. 40, thrown across the pelvis when the head is completely flexed. When the head is not quite so well flexed the suboccipito-frontal diameter, Fig. 42, 4 inches (10 centimetres), is thrown across the pelvis and distends the vulval orifice during the birth of a normal vertex.

Suboccipito-frontal.—From the junction of the head with the neck behind to the prominence of the forehead, 4 inches (10 cm.). This is the diameter thrown across the pelvis when the head is not completely flexed (Fig. 42).

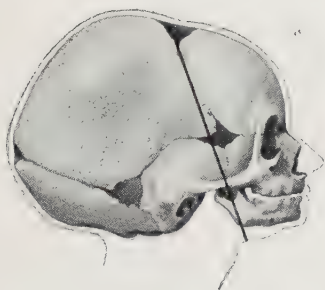


FIG. 43.

Submento-bregmatic diameter,
 $3\frac{3}{4}$ inches (9.3 centimetres).



FIG. 44.

Showing the diameter, Fig. 43, thrown
 across the pelvis in a face presentation with
 the head completely extended.

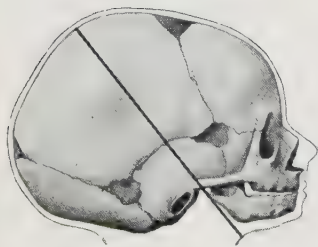


FIG. 45.

Submento-vertical diameter
 $4\frac{1}{2}$ inches (11.2 centimetres).

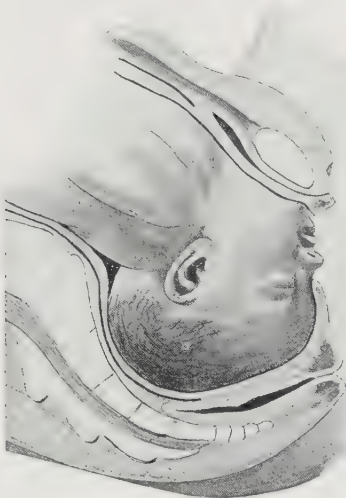


FIG. 46.

Showing the diameter, Fig. 45, thrown
 across the pelvis when the face is presenting
 and the head is not fully extended.

Submento-bregmatic.—From the junction of the head with the neck in front to the middle of the anterior fontanelle (bregma), $3\frac{3}{4}$ inches (9.3 cm.) (Fig. 43). This is the diameter thrown across the pelvis when the face is presenting with full extension of the head (Fig. 44).

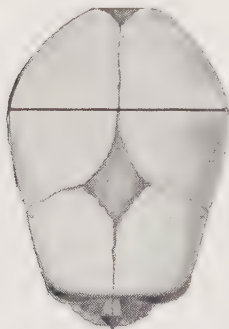


FIG. 47.

Bi-parietal diameter, $3\frac{3}{4}$ inches (9.3 centimetres).

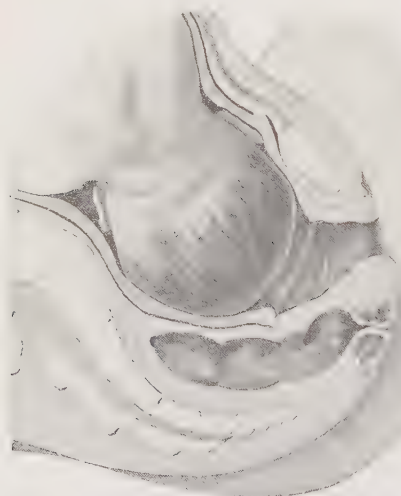


FIG. 48.

Showing the largest diameter entering the transverse diameter of the brim in a flattened pelvis.

Submento-vertical.—From the junction of the head with the neck (Fig. 45) in front, to the farthest point on the vertex, $4\frac{1}{2}$ inches (11.25 cm.). This is the diameter thrown across the pelvis when the face is presenting and the head is not fully extended (Fig. 46); it also distends the vulva at the moment of delivery.

Transverse Diameters

Bi-parietal. — From the points farthest apart on the parietal eminence, $3\frac{3}{4}$ inches (9.3 cm.) (Fig. 47). This is the largest diameter entering the antero-posterior diameter of the brim in a flattened pelvis (Fig. 48).

Bi-temporal.—From the points farthest apart on the coronal sutures, $3\frac{1}{4}$ inches (8.1 cm.).

Bi-mastoid.—From the points farthest apart on the mastoid processes of the temporal bone, 3 inches (7.5 cm.) (Fig. 49).

Superparieto-subparietal.—From above one parietal eminence to below the other, $3\frac{1}{2}$ inches (8.7 cm.) (Fig. 50).

This is the transverse diameter which engages in the pelvis owing to the lateral tilting of the head in flattened pelvis (Naegele's obliquity) (Fig. 51).

Circumference of the Fœtal Head.—The smallest circumference of the fœtal head is that taken in the plane of the suboccipito-bregmatic diameter. It measures $11\frac{1}{2}$ inches (28·7 cm.). A somewhat larger circumference is that taken in the plane of the suboccipito-frontal diameter, the circumference which commonly distends the vulval orifice in normal labour. The largest is that taken in the plane of the vertico-mental diameter. It measures 15 inches (37·5 cm.).

FIG. 49.

Bi-mastoid diameter, 3 inches (7·5 centimetres). The incompressible base. As it is impossible to reduce the length of the bi-mastoid diameter by an obstetrical operation, a flattened pelvis must have one diameter at the brim at least 3 inches long, or a generally contracted pelvis must not have any diameter smaller than 3 inches, to enable the crushed head to be extracted.



The circumference of the fœtal head taken in the plane of the occipito-frontal diameter, measures $13\frac{1}{2}$ inches (34 cm.). This is the circumference that distends the vulval outlet in the birth of an un-reduced occipito-posterior position.

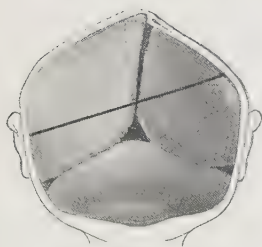


FIG. 50.

Superparieto-subparietal diameter, $3\frac{1}{2}$ inches (8·7 centimetres).



FIG. 51.

Showing the transverse diameter, Fig. 50, which engages in the flattened pelvis owing to the lateral flexion of the head (Naegele obliquity).

The heads of males are, on the average, rather larger than those of females, and the size of the skull and the degree of its ossification often increase with successive pregnancies.

The great folds of dura mater, the falx cerebri and tentorium cerebelli, from their position and attachments, act in some degree as internal ligaments, resisting too great deformity of the plastic foetal head both in the longitudinal, transverse and oblique directions. If moulding is very excessive, or if the foetal head is subjected to severe and sudden stresses, these portions of dura mater are liable to be torn. Some of the great venous sinuses are then in great danger of rupture also. These are the inferior longitudinal sinus, running in the free edge of the falx cerebri and receiving posteriorly the veins of Galen from the brain, and the straight sinus running between the falx cerebri and tentorium cerebelli.

Post-mortem examinations of foetuses still-born or born in white asphyxia after difficult labour, often disclose tears of these folds of dura mater.

DIAMETERS OF THE FŒTAL TRUNK

Bis-acromial.—Between the points farthest apart on the shoulders, $4\frac{3}{4}$ inches (11·8 cm.).

Bi-trochanteric.—Between the points farthest apart on the great trochanters, 4 inches (10 cm.).

CHAPTER X

ANTENATAL CARE

ANTENATAL investigation is to be regarded as a part of preventive medicine, its object being to maintain the mother in health of body and mind, to preserve her pregnancy to term, to avoid difficulty and complication in labour, to ensure the birth of a living and healthy infant, and to help the mother to rear the child.

It is the duty, therefore, of a medical practitioner, on being asked to undertake a confinement case, to point out the necessity of examining his patient and of keeping her under supervision prior to the actual labour in the interest both of the mother and the child.

The number of times a patient should be seen to ensure adequate antenatal care may vary a little, but in an uncomplicated case the following may be considered as the minimal number desirable.

The first visit when the patient comes to make arrangements should be as early as possible, and at this time a full history should be taken and a general examination made. Thereafter the patient should be seen every 4 weeks until the 32nd week, every 2 weeks until the 36th week, and then every week until the onset of labour. If any complications arise, more frequent visits may be necessary.

At each visit the general health of the patient is noted, the blood-pressure should be taken, the urine tested and the weight noted. Every 4 weeks the abdomen should be examined and the increase in the size of the uterus observed. After the 24th week the foetal heart may be heard, and by the 28th week the position of the foetus may be felt. At the 32nd week the position of the foetus should be carefully determined so that any malpresentation may be corrected. At the 36th week the most important observation is whether the foetal head will engage in the pelvis.

If the onset of labour is delayed beyond the expected date of delivery a further abdominal examination should be made to observe whether the foetus appears to be getting too large for the pelvis.

Details of vaginal examinations will be given later.

The investigation should be carried out in a systematic manner. In the first place the history of the patient should be taken. It is important to know whether she has had scarlet fever, rheumatic fever, rubella, chorea, chronic renal disease or a blood-transfusion.

If she has been pregnant before, she should next be questioned with regard to the details of former pregnancies and labours, for

these may provide information of the greatest value. For example, a history of repeated abortions or repeated premature labours, especially with dead or macerated foetuses, will suggest syphilis, chronic renal disease or possibly Rhesus incompatibility. A history of albuminuria, oedema, and convulsions will indicate previous toxæmia of pregnancy, and therefore the need for more careful supervision.

The obstetric history of previous labours is the most important guide as to what is to be expected at subsequent labours. If the patient has had a long labour requiring anæsthesia and instrumental delivery, resulting possibly in the birth of a dead or injured child, or one who has died shortly after birth from intracranial damage, it is possible that the mother has some pelvic contraction or bony deformity. A history of repeated malpositions in previous pregnancies and labours might also suggest the same condition.

It is of great value to know the birth-weight of the patient's previous children. The circumference of the foetal head taken immediately after birth, before the moulding has had time to alter, is an indication of the amount of space in the pelvis and the shape of the bony birth canal, but such information is rarely obtainable.

It is important also to know whether the children were breast or bottle fed, whether they survived, and the cause of death in any who died subsequently. If the patient has been unable after previous labours to nurse her children, or has been able to do so for only a short time, it is often possible in such cases by special attention to ensure the breast-feeding of her infant. If the previous children have died as a result of diarrhoea and vomiting, this may be avoided on a subsequent occasion by educating the mother in the care of her infant, and by the supervision of her management of the child after labour.

The history of the present pregnancy should then be taken. A note should be made of the patient's normal menstrual cycle and the date of her last regular period and of any abnormal symptoms.

The general examination is then made. The height and development are noted together with the gait and any deformity. The heart and lungs are examined for evidence of disease, and cyanosis or breathlessness are noted. In some clinics a routine X-ray examination of the chest is made and this practice has much to commend it. The thyroid is palpated for signs of enlargement, and the eyelids, hands, and ankles are investigated for evidence of oedema. The blood-pressure, systolic and diastolic, is estimated, and the urine is examined, particularly for albumin, casts, pus and sugar. On the patient's first visit, a sample of blood is taken and sent for examination to discover whether she is Rhesus positive or negative, the blood-group should be

determined and a blood-count and Wassermann reaction done. The patient should be weighed at each visit, an undue increase of weight being regarded as evidence of impending toxæmia.

The teeth are liable to decay during and after pregnancy, and they should therefore be inspected and, if necessary, thoroughly overhauled. Not only is this of importance with regard to the maintenance of general health, but also because septic teeth or gums may form the focus for subsequent infection. The tonsils and fauces also need examination since chronic infection of either of them is accompanied by the same danger.

After examining the breasts, (see p. 161) an examination of the abdomen should be undertaken. Full details of this are given in the chapter on obstetric diagnosis.

The external pelvic measurements are of little value but this is a convenient time to take them if they are to be recorded. (See page 81). The legs are examined to exclude the presence of rachitic or other changes which might be accompanied by deformity of the pelvis.

In most clinics a vaginal examination is made at the patient's first visit. At this examination the early enlargement of the uterus can be noted and its position, anteverted or retroverted, determined. The important thing here is to look for any abnormal swellings such as an ovarian cyst or a fibroid. Some idea of the general shape of the pelvis may be made, but efforts to measure the pelvis are perhaps better postponed until later in pregnancy when the soft tissues are more easily stretched. This second vaginal examination to measure the pelvis and estimate its shape, may conveniently be made about the twenty-eighth to the thirty-second week, when the tissues are more relaxed and the risk of disturbing the pregnancy is very slight. (For details see Pelvimetry.)

At the end of the patient's first visit she should be told to attend once a month, when the height of the fundus should be recorded, the urine tested and the blood-pressure estimated. At the 32nd week the position of the foetus should be made out, as this is the best time to correct a malpresentation if found (see p. 106).

At the 36th week the most important observation is to determine whether the largest diameter of the head has passed the brim of the pelvis, or, if it is still above the brim, whether it can be pressed in. If there is any doubt about this it suggests that there may be some disproportion between the size of the foetal skull and the pelvis. This will be considered in further detail later.

The patient should be advised to notify her doctor at once should any of the following symptoms arise: persistent headache; disturbance of vision; swelling of the face or ankles; bleeding.

During pregnancy the patient should be advised to attend the instruction classes which are now generally available at ante-natal clinics (see p. 99).

Diet.—During pregnancy there is no need for any appreciable increase in the calorie value of the patient's diet; but the distribution of its constituents requires alteration. The protein and the mineral salts should be increased to supply the needs of the foetus. The fats should remain adequate to ensure sufficient intake of calcium and vitamins A and D, and the carbohydrates should be reduced a little to keep the total intake to a reasonable level, and prevent excessive gain of weight.

During pregnancy a careful check should be kept on the patient's weight. Providing it is within normal limits at the outset, the increase should not exceed 28 pounds during the pregnancy. There is very little, if any, increase during the first 12 weeks; after this the increase should be at the rate of about 4 pounds every 4 weeks. If it exceeds 5 pounds during that period, in the absence of any evidence of toxæmia, it must be considered excessive and carbohydrates should be reduced.

A number of very interesting investigations on the effects of diet on the outcome of pregnancy have been made. It has been shown that a poor quality diet predisposes to premature labour and stillbirth (Aberdeen). A poor quality diet too has been shown to increase the incidence of toxæmia (Toronto). Another investigation showed that the addition of iron and vitamins to a poor diet reduced the risk of both premature labour and toxæmia. There is considerable evidence that excessive gain of weight during pregnancy predisposes the patient to toxæmia of pregnancy, and an investigation carried out in Australia has shown that careful avoidance of excessive gain of weight by a diet rich in proteins, vitamins and low in carbohydrates, has almost eliminated toxæmias of pregnancy, and has reduced the incidence of difficult labour due to large size of the foetus.

All the evidence, therefore, emphasizes the importance of a carefully balanced diet during pregnancy. Protein should be increased and at least two-thirds of the protein should be of animal origin, *i.e.* meat, milk, eggs, cheese and fish.

Fats.—The intake of fats should be adequate: it will be, if sufficient milk, cheese, eggs and meat are taken, for they help in the absorption of vitamins A and D. Extra fat is unnecessary. Carbohydrates should be reduced slightly to compensate for the increased calorie value of the protein intake.

Mineral salts.—In the latter half of pregnancy there is a need for a considerable increase in the intake of calcium, phosphorus and iron,

and probably other trace elements to supply the needs of the growing foetus, and to prepare the mother for lactation. Milk, cheese, eggs, meat and fresh green vegetables are foods rich in mineral salts, and a well balanced diet will contain sufficient minerals. The average adult diet in this country is, however, barely sufficient so that unless special care is taken by the patient, it may be necessary to increase the intake of calcium.

Calcium.—The amount of calcium required daily by an adult is metric equivalent 0·5 g.; during pregnancy and lactation the amount is increased to metric equivalent 1·5 g. It is contained in milk, cheese, some vegetables and bread. It is difficult to be sure that all the calcium taken is absorbed; for example, the phytic acid of bread flour produces an insoluble salt of calcium. Again vitamin D is necessary for the absorption of calcium, so that it is desirable that every pregnant woman should take a calcium preparation containing vitamin D. A daily dose equivalent to metric equivalent 30 gr. of calcium lactate is sufficient.

Iron.—Many women start pregnancy with a slight degree of anæmia, so that it is always wise to check the hæmoglobin level throughout pregnancy and give iron medicinally if it is found to be below normal. The preparation most commonly used is ferrous sulphate, 3·6 gr. three times a day after meals. This preparation may cause slight irritation of the gastric mucosa in a few patients, and such patients may tolerate ferrous gluconate, 3 gr., better. (See Anæmia, p. 264.)

Exercise.—The natural tendency for a pregnant woman is to rest more than usual, particularly as full time is approaching. This desire must be combated up to a point, since it is essential that the patient should have plenty of fresh air and walking exercise daily, not only to keep her in health during her pregnancy, but also to fit her for the increased muscular efforts which will attend her labour. Light housework is quite harmless. All exercise of a violent nature, however, should be avoided on account of the risk of miscarriage.

Education of the Expectant Mother.—It is obvious from what has been said about diet that the young mother will benefit from some instruction and in most clinics classes are arranged for this purpose. There are many other subjects on which instruction may be useful, such as the preparation of the baby's clothes and the advantages of breast feeding. It is important that the patient's anxiety about labour should be allayed, for fear undoubtedly plays some part in delaying the process. A simple explanation of the stages of labour should therefore be given to the patient so that she may know what to expect.

This too is a convenient time to demonstrate the use of the gas and air or trilene apparatus for analgesia. It is also helpful if the ward sister can meet the patient so that when she arrives in labour she finds herself amongst friends.

In many clinics patients are given a course of instruction in antenatal exercises. These exercises are directed more to the patients' posture and general physique than to the muscles specially concerned with childbirth. Many patients benefit from instruction in the relaxation of muscle tone, so that they may be able to relax completely in the short intervals between their labour pains.

If this programme is carefully carried out, the majority of patients will be physically fit at the onset of labour and may approach the ordeal with less apprehension.

Regulation of the Bowels.—Constipation is a troublesome complication in most pregnant women. Strong purgatives must be avoided since they are liable to cause miscarriage. If by attention to the diet, which should include plenty of vegetables and fresh fruit, a proper and daily evacuation of the bowels can be ensured, well and good; otherwise mild aperients, such as cascara or senna may be prescribed. Liquid paraffin may also be usefully prescribed.

Treatment of the Nipples.—This is discussed on pp. 161 and 162.

Examination of the Urine.—The urine of a pregnant woman should be examined for albumin and sugar at least once a month till the 32nd week, once a fortnight till the 36th week and then weekly till labour starts. It is only by repeated examination of the urine that the first indications of pre-eclampsia can be detected, and many women have lost their lives owing to the neglect of this simple precaution. The patient should be warned to report, without delay, a marked diminution in the amount of urine passed.

Estimation of Blood-Pressure.—Blood-pressure readings, systolic and diastolic, should be made with the same frequency as examination of the urine. In the early stages of toxæmia, a rise of blood-pressure will usually be observed before albuminuria. The blood-pressure is generally considered to be raised if the systolic reading is above 140 mm. Hg. and the diastolic above 80 mm. Hg.

Nervous System.—A pregnant woman should be shielded as far as possible from all worry and excitement. Sleeplessness, which is at times a somewhat troublesome complication, may be treated, if severe enough, with suitable hypnotics.

Inquiries are not uncommonly made as to the advisability of coitus during pregnancy. It is generally considered that coitus increases the risk of miscarriage during the first 12 weeks, and must be avoided during the last 2 months to prevent infection.

Corsets.—These will seldom be necessary in a healthy young woman with good abdominal muscles, but she should be advised to wear a suspender belt to support her stockings and not wear garters which will accentuate the tendency to varicose veins. In multiparæ, if the abdomen is pendulous, a properly fitting corset should be advised. Support of the breasts by a brassiere is often necessary, but it should not be tight and pressure on the nipples should be avoided.

MINOR DISORDERS OF PREGNANCY

Morning Sickness.—From the 6th to about the 12th week nausea or vomiting in the early morning is so common that it is described as one of the symptoms of pregnancy. It is most marked soon after waking and is generally retching rather than vomiting, and may be relieved by eating a dry biscuit or taking a glucose drink on waking. If the patient vomits frequently after her meals, this is abnormal and is considered in the chapter on Excessive Vomiting of Pregnancy.

Varicose Veins.—Varicose veins of the lower limbs or of the vulva may cause considerable distress during pregnancy, and serious hæmorrhage may arise from the latter during labour. In the legs and ankles varicosity may be associated with œdema, varicose eczema, ulceration, and with thrombosis. Fortunately pulmonary embolism is extremely rare. Rest, and support by means of crêpe bandages, or elastoplast in case of ulceration, afford relief.

Surgical treatment during pregnancy is not generally advised because the condition often improves very much after the baby is born.

Hæmorrhoids.*—Hæmorrhoids are not infrequent sources of pain and of hæmorrhage during pregnancy. Surgical procedures are contra-indicated. Suitable aperients should be prescribed; the anal region should be carefully cleansed and dried after each evacuation of the bowels, and astringent analgesic ointments applied.

Pruritus Vulvæ.—Any excess of vaginal discharge may cause some irritation of the vulva, early in pregnancy a gonococcal infection may be responsible, but far the commonest cause in the later months is a monilial infection of the vagina which is associated with the increased tendency to glycosuria which is seen during pregnancy. In

a few cases a local cause cannot be found to account for the itching which is not always confined to the vulva.

In all cases of pruritus the urine should be tested for sugar, and if there is any reason to suspect that the patient has diabetes, the blood-sugar should be estimated. A smear from the vagina should be examined microscopically and cultured, and this may show monilial threads. Inspection of the vaginal walls may show the typical appearance of a monilial infection; a general redness of the vagina with numerous plaques of cheesy material lightly adherent to the vaginal epithelium being seen.

Monilial infections are difficult to eradicate during pregnancy although they nearly always clear up quickly after delivery. It is generally necessary to reduce the carbohydrate intake and so reduce the amount of sugar in the urine. Local treatment consists of carefully cleaning the vagina till all the monilial deposits have been removed, and the painting of the vagina with a one per cent. aqueous solution of gentian violet. It may be necessary to repeat this treatment every 3 days for several weeks.

An alternative method of treatment is by the antibiotic nystatin. The patient should be instructed to insert a vaginal tablet containing nystatin each morning and evening for 7 to 10 days. This method is generally very successful in the nonpregnant patient but during pregnancy the hypertrophy of the vaginal epithelium increases the difficulty of curing the condition completely until after delivery.

Trichomonal infection of the vagina may occur during pregnancy but seldom causes pruritus.

Salivation.—An increase in the amount of saliva occasionally occurs during pregnancy and it may prove a most distressing complication. The increase occurs, as a rule, during the early part of pregnancy, and coincides in time with the period of morning vomiting. There is a tendency for the symptom to recur in succeeding pregnancies. The effects upon the patient are distressing, not only because of the unpleasantness of the symptom, but because she is so constantly disturbed. There may be an accompanying rapid loss of weight from the loss of body fluid.

Treatment is difficult. The administration of belladonna and thyroid extract have been followed by good results. Psychological factors should be borne in mind and treated as such.

Herpes Gestationis.—This skin disease, which is peculiar to pregnancy, is attributed to toxic neuritis. It has been known to occur in the same patient in successive pregnancies. The patient

complains of itching and burning which at times become intolerable. The rash at first appears on the buttocks and legs, and may eventually affect other parts of the body. It assumes a multiform character, and is grouped after the manner of herpes; erythematous patches, papules, vesicles, pustules, and bullæ appearing indiscriminately. Herpes gestationis has no effect on the pregnancy, but the sleeplessness arising from the irritation may cause the woman to become exhausted.

Locally bismuth and starch powder or lotions of carbolic acid or mercury should be applied. A dermatologist should be consulted.

CHAPTER XI

OBSTETRICAL DIAGNOSIS

CERTAIN terms used in connexion with the child and its relation to the uterus must be explained.

Lie.—By the lie of the child is meant the relation which the long axis of the child bears to that of the mother. The lie may be longitudinal, oblique or transverse.

Presentation.—The presentation depends on the part of the child which occupies the lower segment of the uterus, lying just above the internal os. When the head occupies the lower segment of the uterus it represents a cephalic presentation; if it is flexed on the spine, the presentation is a vertex; if fully extended on the spine, a face presentation; if midway between flexion and extension, a brow presentation. If the breech occupies the lower part of the uterus, the presentation is a breech. If a knee or a foot lies lowest, the presentation is said to be a knee presentation or a footling, both of which are varieties of breech presentation. If the child lies obliquely, the shoulder generally lies over the internal os, so that it is called a shoulder presentation.

Position.—By the term position is meant the relation which some given part of the child bears to the front or back of the mother. If the back of the child is directed to the front, it is a dorso-anterior position, if to the back, a dorso-posterior.

Attitude.—The term attitude refers to the relation of the different parts of the child to one another. If the back, head and limbs are flexed, the child is said to be in an attitude of flexion; if extended, in an attitude of extension. The usual attitude is one of flexion. The back is arched, with a dorsal convexity; the head is flexed towards the chest; the thighs are bent up towards the abdomen; the knees are bent, and so are the arms and forearms.

In 96 per cent. of cases at term the child lies longitudinally, with the head in the lower uterine segment, and the breech in the fundus. The reason for this is found in the fact that at full time the foetus has to adapt itself to the shape of the uterus. In the early months of pregnancy the liquor amnii is comparatively more abundant,

and the foetus can float freely; but as pregnancy advances, and the foetus rapidly increases in size, the quantity of liquor amnii becomes comparatively less. Consequently, at term the foetus can no longer float freely, but has to adapt itself to the shape of the uterus. When the attitude is one of complete flexion, the buttocks with the adjacent parts of the thighs and the feet constitute a mass larger than the head. The cavity of the uterus at full time is pear shaped, with the larger end uppermost; therefore the foetus fits into it best when the breech lies in the upper part of the uterus, and the head in the lower part.

In premature labour, presentations other than those of the head are much more common than in full time labour for two reasons: first, because the liquor amnii is comparatively more abundant; and, secondly, because the head is comparatively larger in premature children than in those born at term.

If the head is disproportionately large at full time, *e.g.* in hydrocephalus, the child is likely to present by the breech, the enlarged head being larger than the breech, and so occupying the fundus, the larger end of the uterus.

If there is excess of liquor amnii (hydramnios), malpresentations are likely to result, the child being able to move about freely, and not having to adapt itself to the shape of the uterine cavity.

If the head cannot readily enter the brim of the pelvis, a malpresentation is likely to occur. This may be seen when the pelvis is contracted or a placenta previa or pelvic tumour diminish the space available.

If the tone of the uterine and abdominal muscles is poor, as is often the case in patients who have had a large number of children, the factors which normally produce a longitudinal lie no longer exist and the foetus may lie transversely or obliquely. When the tone of the uterus improves just about the time of the onset of labour, this malposition may be corrected provided that the membranes have not ruptured.

The movements of the foetus also assist in making it assume a longitudinal lie. A shoulder or breech presentation is more likely to occur with a dead than with a living child, because of the absence of movements and the absence of the child's muscle tone.

The back of the child is much more commonly directed towards the front than towards the back of the mother. This is due to the child's having to adapt itself to the shape of the uterine cavity; which must, during relaxation, be much less concave behind than in front, because of the convexity forwards of the lumbar part of the spine on which it lies. The concavity of the foetal body fits the convexity of the maternal spine when the back of the foetus is directed forwards.

If the back of the foetus is directed towards the back of the mother, the two convexities are in contact, and the foetus cannot fit the shape of the uterine cavity unless its back is less flexed than normal.

In cases in which the mother's abdominal wall is weak (pendulous belly), the uterus sags forward, and is not held up against the spine and the foetus tends to lie with its back posterior and malpresentations such as occipito-posterior, brow or face may result.

The pregnant uterus has usually a slight right lateral obliquity, *i.e.* it leans towards the right side. There is usually also some rotation to the right, the anterior surface looking slightly to the right. The transverse diameter of the uterine cavity is thus in the right oblique diameter of the mother's abdomen. The antero-posterior diameter of the child occupies this, the greatest, diameter of the uterus when the back lies in front and to the left.

Abdominal Examination.—Abdominal examination is most important, and should always precede vaginal examination.

By abdominal examination it is possible to ascertain:—

1. The size of the uterus and to note whether it corresponds with the period of amenorrhœa.
2. The lie, position, attitude and presentation of the foetus.
3. Whether the presenting part has entered the pelvis or not, and so to form an idea as to the relative sizes of the presenting part and the brim of the pelvis.
4. The presence of abnormal conditions, such as excess of liquor amnii, twin pregnancy and abdominal tumours.
5. Whether the child is alive or not.
6. Some idea as to the size of the child.

The patient should lie on her back, with her head on a pillow her abdomen uncovered, and her knees slightly drawn up.

Inspection.—The examination should begin by a careful inspection of the abdomen. The height of the fundus and the general shape and size of the uterus can always be seen. In most cases foetal parts and foetal movements may be seen. In primigravidæ with the head engaged in the pelvis, if the back of the foetus is to the front, the abdomen will appear to rise smoothly from the symphysis pubis. If the occiput is posterior, a flattening of the abdomen may be observed above the pubis. If the head is unduly large it may be seen above the pelvic brim and occasionally the head can be seen in the fundus in a breech presentation. If the lie is transverse the uterus will appear wider than usual though the height of the fundus may be a little lower than in a longitudinal lie. If twins are present the uterus also appears wide but the height of the fundus will be above the normal.

Palpation.—The fingers of both hands must be used, and laid nearly flat on the abdomen. The hands must be warm, and the patient, if nervous, must be engaged in conversation and put at her ease.

As the majority of foetuses present by the vertex, the lower part of the uterus should be palpated first to establish definitely that it is a vertex presentation and because no opinion is of any value until the head has been identified. This is done by standing on the patient's right side, facing her feet and placing both hands on the lower abdomen above the pelvic brim (Fig. 52). The head is recognized because it is rounder and harder than the breech. The mobility will depend upon its relation to the 'pelvic brim. If it is completely above the brim it is freely movable and is spoken of as a 'floating head' and the fingers of both hands can be made to meet below it; if the widest diameter has passed through the brim, the head is usually fixed and is said to be engaged in the brim; if it is deeply sunk in the pelvic cavity it may be difficult to feel at all though usually with persistence it can just be reached by the finger tips. In this method of examination the forehead is more easily felt, when the head is well flexed, because it lies at a higher level than the occiput.

If the head is above the brim of the pelvis, it may be felt more easily by the single-handed method shown in Fig. 53.

When the head is above the brim, moderate pressure will generally make it engage in the pelvis. This is best done by making downward pressure on the breech of the foetus with the left hand, to bring the head over the inlet to the pelvis, and then pressing the head backwards with the right hand. Another method is to raise the patient's head and shoulders half way to the sitting position, when the head will often enter the brim, and the same thing may be observed if the patient is examined while standing.

The fundus should then be palpated with both hands. If the breech occupies the fundus a large body will be felt, rather irregular in outline, not so round or hard as the head. When the fingers are moved downwards on to the back, they will not feel anything corresponding to the prominences of the shoulders between the breech and the trunk. A knee or a foot, or both, can generally be felt at a short distance from the breech, at a slightly lower level.

If the head occupies the fundus, a harder, rounder, smoother and more movable mass than the breech will be felt. The anterior shoulder will probably be felt, and the head can be moved independently of the body. As a rule, the small parts of the foetus cannot be felt near the head. The fundus of the uterus is usually narrower when it contains the head than when it contains the breech.

The sides of the abdomen are next palpated to feel in which of them the back lies. If the back of the foetus is directed more to the front than behind, a broad, smooth resisting surface will be felt

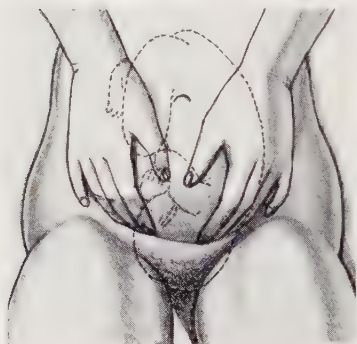


FIG. 52.

The head, which is well flexed, has sunk into the brim of the pelvis too deeply for palpation as in Fig. 53; both hands must be used, the tips of the fingers being pressed in deeply at the sides of the pelvis.



FIG. 53.—ABDOMINAL PALPATION.

The head, which is well flexed, has not sunk deeply into the brim of the pelvis.



FIG. 54.—ABDOMINAL PALPATION.

The breech is found to occupy the fundus.



FIG. 55.—ABDOMINAL PALPATION.

On the left side the back is felt as a broad smooth resisting surface; on the right side the limbs are felt as small movable parts.

on one side of the abdomen, and on the other side small knobs or lumps—the limbs. If these small parts are felt all over the front of the abdomen, the back must be directed to one side and

backwards, and deeper palpation in the flank may be necessary to ascertain on which side it lies. During this part of the examination some idea can be gained of the amount of liquor amnii that is present (Fig. 55).



FIG. 56.—ABDOMINAL PALPATION.

The fœtus is lying obliquely. The head can be felt in the left iliac fossa, and the breech at a higher level on the right side



FIG. 57.—AUSCULTATION OF THE FETAL HEART.

The crosses indicate the points where the foetal heart-sounds are heard best in dorso-anterior positions with vertex and breech presentations respectively.

If the foetus is lying obliquely, the head will probably be felt in one iliac fossa, and the breech a good deal higher up on the other side (Fig. 56).

The presence of twins may be diagnosed by the detection of two heads.

Auscultation.—The foetal heart must next be listened for. It is heard best by listening over the back of the foetus in vertex and breech presentations, and over the chest in face presentations. It may be heard over a large area in some cases, but the point of maximal intensity is usually as indicated in Fig. 57. If the back is felt in front and to one side in a *vertex presentation*, the heart will be best heard an inch or two to that side of the middle line. Take the mid-point of the inguinal ligament, and imagine a line drawn from this point to the umbilicus. The middle of this line is the best place at which to listen.

In *occipito-posterior* positions—*i.e.* when the back is directed to one side and backwards—the heart is best heard either in the flank or in the middle line.

In *breech presentations* the heart will be heard at a point higher up than in vertex presentations—at the level of, or a little above the umbilicus. The reason for this is that the breech does not engage in the brim so early in labour as does the vertex; it sits on the brim rather than in it, except cases of extended legs.

When the back is extended, in *face presentation*, the foetal heart is best heard on the side on which the limbs are felt—*i.e.* by listening over the foetal chest, not over the back.

Vaginal Examination.—A vaginal examination is usually made at the patient's first attendance at the antenatal clinic (see p. 97), but this is seldom the best time to try to estimate the capacity of the pelvis. In most clinics the measurements of the pelvis are taken about the 30th week, by which time the tissues have softened and relaxed, and examination is easier. In making a vaginal examination during pregnancy routine antiseptic precautions should be taken.

The examination may be made either with the patient on her back or on her left side. The vulva should be inspected and prior to examination, it should be swabbed with an antiseptic lotion. A sterile glove should be worn, and an antiseptic cream used as a lubricant. The first and second fingers are inserted into the vagina, and as the fingers enter, the angle made by the pubic bones where they join at the symphysis may be noted. Some impression of the shape of the pelvis may be gained by palpating the ileopectineal line at the brim of the

pelvis, and the ischial spines can be felt and a rough estimation of their distance apart may be made.

The anterior surface of the sacrum should be palpated to estimate whether it is concave or flattened and an attempt should be made to feel the promontory of the sacrum; if it is felt the measurement of the diagonal conjugate should be made. These observations are best made in the antenatal department, but if a patient is first seen in labour, they should be attempted at that time. In labour the most important observations will be the degree of dilatation of the cervix, whether the membranes are ruptured or not, and the recognition of the presenting part and the estimation of its position in the pelvis.

Occasionally vaginal examination may be difficult, either because of obesity or because the patient is unusually sensitive; in such cases an anaesthetic should be given.

In all cases in which there is difficulty in determining the position of the foetus or the size of the pelvis, an X-ray examination should be made.

X-ray Examination.—In any case in which there is difficulty in making a diagnosis or in which the findings suggest an abnormality, a radiograph will very often be of great help. Unfortunately there is some evidence that exposing the foetus to irradiation, particularly in the early weeks of pregnancy, may be injurious. It is known that excessive exposure may produce foetal abnormalities and may also cause abnormal mutations in the genes of the sex cells. A recent study suggests that even moderate exposure may slightly increase the incidence of leukæmia during the early years of life. It is therefore wise to avoid X-ray examination as much as possible during pregnancy.

In many instances the difficulty of diagnosis can be resolved by a more skilful observer, or by examination under an anaesthetic. When it becomes necessary to resort to a radiographic examination, the exposure should be kept to a minimum. A skilled radiologist with modern apparatus will be able to obtain the maximal information with the minimal risk. If the diagnosis is in doubt the life of the foetus and possibly the mother may be threatened so that it is better to take an X-ray photograph even if it is associated with a small hazard. These facts should be kept in mind in considering the following points in which a radiograph may help in the diagnosis.

The Diagnosis of Pregnancy.—Because of the dangers of irradiation to the foetus X-rays in early pregnancy should be avoided. After the 16th week X-ray examination will, as a rule, provide positive evidence of pregnancy, and this may be useful in any case which has a medico-legal aspect.

Fœtal Maturity. Although in the past many efforts have been made to estimate the maturity of the foetus by X-rays, none of the methods has proved to be of much value. The appearance of the



FIG. 58.—PREGNANCY OF 36 WEEKS. BROW PRESENTATION.

centres of ossification of the bones are very variable and the difficulty of their demonstration is considerable. If the centre of ossification of the lower end of the femur can be demonstrated *in utero*, it is almost certain that the foetus is sufficiently mature to survive birth.

It is possible but difficult to measure the foetal skull *in utero* (cephalometry) but generally speaking a clinical estimate is quite as satisfactory.



FIG. 59.—INTRA-UTERINE DEATH OF THE FŒTUS.

Spalding's sign is present. There is marked overlapping of the bones of the vault of the skull.

The Lie, Position and Attitude of the Fœtus.—Although these can always be determined accurately by X-rays in the later weeks of pregnancy, this should seldom be necessary. An X-ray examination may occasionally be necessary in cases of hydramnios or gross obesity.

Multiple Pregnancy. The presence of twins or triplets can be diagnosed with certainty by X-rays in the later months of pregnancy.

The radiological diagnosis of multiple pregnancy may be made as early as the 16th week, but one foetus may easily be missed at this stage, particularly if there is an excess of liquor in one amniotic sac.

Foetal Abnormalities.—X-ray examination should be undertaken whenever a foetal abnormality is suspected, and in all cases of hydramnios. Anencephaly and gross hydrocephalus are easily recognized, but lesser degrees of hydrocephalus should be diagnosed with caution, as separation of the skull bones may be deceptive, and the position of the foetal skull relative to the film may give an appearance of enlargement, especially in an antero-posterior film of a breech presentation. Spina bifida may occasionally be seen if the position of the foetus is favourable to its demonstration, and it should certainly be looked for in cases of hydrocephalus. Gross foetal ascites may be diagnosed by X-rays, and should be looked for when there is a possibility of hydrops foetalis. Rare monstrous formations of the foetus may also be detected.

Intra-Uterine Death of the Foetus.—The most reliable sign of foetal death *in utero* is over-riding of the bones of the vault of the skull (Spalding's sign). This sign may be demonstrable 48 hours after foetal death, or it may be delayed for a week or more. Some over-riding of the tabular bones of the vault occurs during labour from moulding, but with this exception over-riding can be taken as a definite evidence of foetal death. Minor degrees of over-riding should be interpreted with caution, and the absence of over-riding cannot be interpreted as evidence of a live foetus. Marked hyperflexion of the foetus, or contortionist attitudes of the foetal limbs, may be taken as supporting evidence of foetal death, but is not so reliable as Spalding's sign. The presence of gas in the vascular system of the foetus may also be seen with a dead foetus *in utero*.

Abnormalities of the pelvis and placenta prævia will be considered in the chapters on these subjects.

CHAPTER XII

LABOUR

PREGNANCY is terminated by the onset of labour approximately 280 days from the first day of the last menstrual period. The cause of the onset of normal labour has not as yet been determined, but certain facts are known. There is a gradually increasing concentration of oestrogens in the blood. Under their influence the uterine contractions become more co-ordinated and powerful as term approaches, but, up to the end of gestation, this action is held in abeyance by the antagonistic action of progesterone. It has been suggested that the increasing irritability of the uterus produced by oestrin will reach a point when it will respond to the secretion of the posterior pituitary lobe, but it has been shown that the onset of labour is not delayed or interfered with in hypophysectomized rabbits. Evidence of the part hormones play is too fragmentary at present, but it is possible that labour is brought on by some hormonal stimulation of the intrinsic ganglia of the uterus or of its muscle following preliminary sensitization by oestrogens.

The early theories put forward, such as the increasing distension of the uterus, especially of the lower segment, the changes in the decidua and the degeneration of the placenta, which occur at the end of gestation, may play a contributory part. In a recently reported case a patient with a double uterus had a pregnancy in each. The pregnancy in one uterus was abnormal and was expelled at the 34th week. In the other uterus the pregnancy was normal and continued to term. This certainly suggests that the cause of onset of labour is local rather than systemic.

Quite apart from the natural mechanism of onset, in some instances labour may be started abnormally by stimulation of the uterus. This stimulus may be either direct, as in the induction of premature labour by rupture of the membranes, or indirect, as by violent purges and possibly by emotional shock.

For the consideration of the phenomena of labour the uterus must be divided into three parts which behave differently during labour.

1. **The Cervix.**—This is dilated mechanically, playing a mainly passive part except that there is active relaxation of its circular fibres.

2. The Lower Uterine Segment.—At term the lower uterine segment extends upwards for about 7·5 cm. (3 inches) above the internal os. A definite anatomical landmark cannot be given as the upper limit of the lower uterine segment, except that in front it corresponds with the lower limit of firm attachment of peritoneum to the uterine muscle. The lower uterine segment has its shape altered during labour from that of a hemisphere to that of a cylinder, its walls becoming stretched and thinned as labour advances until there is room for the foetus to pass through (Fig. 61).

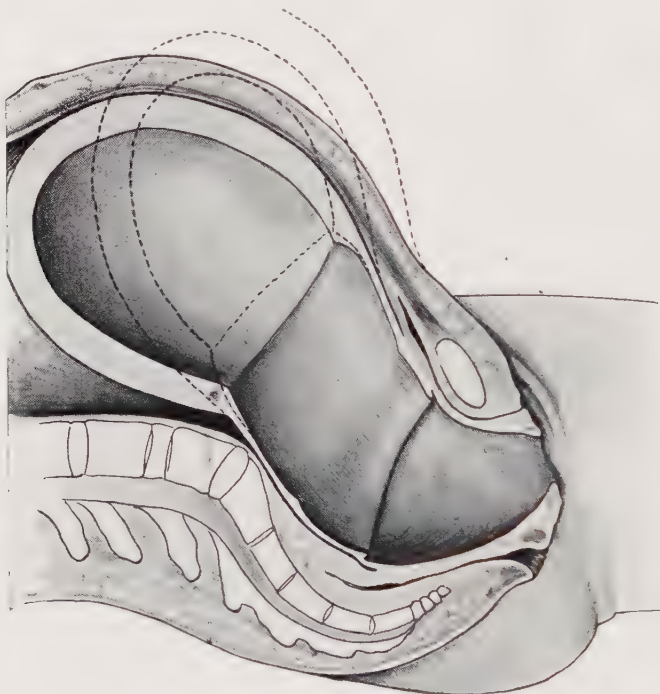


FIG. 60.—DIAGRAM TO SHOW THE THICKENED UPPER UTERINE SEGMENT AND THE THIN LOWER UTERINE SEGMENT.

The dotted line shows the position assumed by the uterus during contraction.

3. The Upper Uterine Segment.—This comprises the greater part of the body of the uterus. The walls of this part of the uterus become progressively thicker from retraction of the muscle-fibres as labour advances, and as the contents of the upper uterine segment are more and more accommodated in the lower segment and cervix.

In labour the lower uterine segment, cervix, vagina, pelvic floor, and vulval outlet are dilated until there is one continuous birth-canal (Fig. 60). The forces which bring about this dilatation and expel

the foetus are supplied by the contraction and retraction of the muscle of the upper uterine segment, with assistance in the second stage from the abdominal muscles, including the diaphragm.

The muscular fibres of the upper segment of the uterus can contract, relax, and retract. When contracting, the fibres become shorter and thicker. In retraction they do not return to their original length, although the active contraction has passed off. In relaxation muscle-fibres lengthen and become thinner, returning to the original length. If contraction is followed by relaxation, only temporary shortening is produced. If retraction accompanies contraction, some

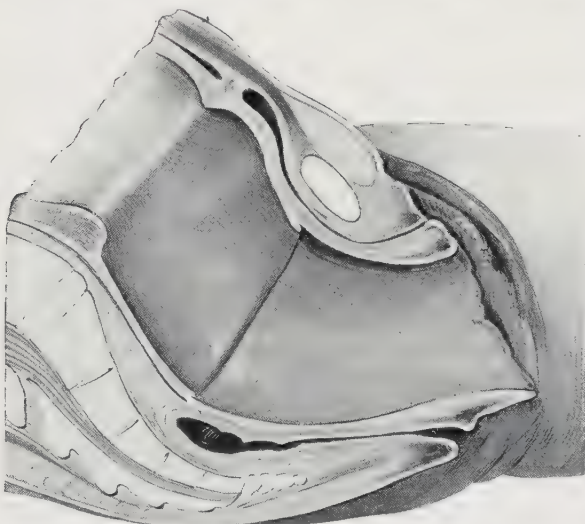


FIG. 61.—THE BIRTH-CANAL.

The lower uterine segment, cervix, vagina, pelvic floor and vulval outlet have been dilated and form a continuous canal. There is still a slight ridge marking the lower limit of the cervix.

of the shortening of the muscle-fibres is permanent. Retraction is a property which, though not peculiar to uterine muscle, is more marked in the uterus than in any other organ. It is evident that retraction occurs independently of active contraction and, moreover, contraction can be superimposed on retraction. If there is no retraction, each individual contraction starts at the same point, as regards the size of the uterus, as its predecessor. When retraction is present, however, each successive contraction starts at the point where its predecessor left off, the uterine cavity becoming permanently smaller as the result of each successive contraction, thus preventing the child slipping back.

When the foetus is being expelled, the retraction of the uterine muscle keeps the inner surface of the uterus in contact with the

fœtus, as if it were moulded to it. When the placenta is expelled, retraction enables the uterine walls to come together so that there is only a potential cavity.

For the pathological effects of retraction see Obstructed Labour (p. 334).

During pregnancy the internal os is kept closed, by the contraction of its circular fibres, such as occurs in the sphincter muscles of other hollow viscera. Throughout pregnancy with increasing frequency irregular painless contractions of the muscular fibres of the body of the uterus occur, followed by relaxation and accompanied by only a minimal amount of retraction. It is this small amount of retraction which is responsible for the dilatation of the lower segment and cervical canal found in many primigravidæ in the last weeks of pregnancy.

Forcible dilatation of the internal os causes contraction of the body of the uterus, and conversely contraction of the body of the uterus causes dilatation of the cervix. This has been referred to as the polarity of the uterus.

The Stages of Labour.—Labour is divided into three stages :—

1. The *first stage*, or stage of dilatation, lasts from the onset of the true labour pains until the os uteri is fully dilated.
2. The *second stage*, the stage of expulsion of the child, lasts from the full dilatation of the os uteri until the child is born.
3. The *third stage* lasts from the birth of the child until the placenta and membranes are delivered.

Premonitory Symptoms.—In most primigravidæ, the presenting part sinks into the pelvis during the last 3 or 4 weeks of pregnancy, and this is spoken of as “lightening” because the descent of the uterus reduces the upper abdominal distension, making the patient more comfortable.

In many multiparæ the presenting part does not engage until labour begins. In some the presenting part goes into the pelvis 2 or 3 days before the onset of labour, and such experienced patients may recognize that labour is likely to start within a few days.

False pains are common during the last 2 or 3 weeks, *i.e.* pains which are not true labour pains. Their presence may make the patient think that labour has begun, or she may recognize the fact that they are not labour pains. These false pains may be distinguished from labour pains in the following way :—

1. True labour pains are felt in the abdomen and in the lower part of the back; false pains always in the abdomen.
2. True labour pains occur with a certain regularity, and the hand placed on the uterus feels it harden during a pain. False pains

occur at irregular intervals, and are not accompanied by hardening of the uterus.

3. False pains are usually of gastro-intestinal origin and disappear after an enema or purgative, both of which increase the strength and frequency of true pains.

Symptoms and Signs of the Onset of Labour.—These are three :—

1. The pains ; 2. The shortening and dilatation of the cervix ; and 3. The show.

1. The Pains.—As has been stated earlier the uterus contracts irregularly and painlessly throughout pregnancy. Labour is recognized by the changes which take place in these contractions, in that they become regular and painful and are known as labour pains. The difference is due to the fact that in labour contraction is followed by retraction, so that the next contraction must cause some corresponding dilatation of the lower segment and cervix. It is this dilatation which is associated with pain. The uterus can be felt to harden during each contraction which begins gradually, works up to a period of maximal intensity and then dies away. At the onset of labour the interval between contractions is about 20 minutes but it is typical of normal labour that the contractions increase in frequency, strength and in their painful quality, until at the end of the first stage they are coming every 3 minutes and lasting as long as 1 minute.

The pains are spoken of as being involuntary, inhibitable, peristaltic, and intermittent. Although they are beyond the control of the patient's will, occurring even when she is unconscious, they may be inhibited, lessened in frequency, or temporarily abolished by emotion, nervousness at first sight of the obstetrician or by distension of bladder or rectum ; also they may be increased in strength and frequency by such stimuli as a purgative, a hot enema and stretching of the cervix or perineum by the presenting part.

The fact that the contractions are intermittent and not continuous is of great importance to both the fœtus and the mother during the first and second stages of labour. During a pain the circulation through the uterine wall is stopped, and if the uterus contracts continuously the fœtus dies from lack of oxygen. The intervals between the pains allow the placental circulation to be re-established, and give the mother time to recover from the fatiguing effect of the contraction. The uterus is a very large muscle, and a long-continued contraction uses up much of the patient's energy. This recurring drain on her strength, if allowed to continue for too long, produces maternal exhaustion.

2. The Shortening and Dilatation of the Cervix.—If the cervix is not sufficiently dilated to allow the finger to feel the bulging of the bag of membranes during the pains, its shortening is the safest sign on which to base an opinion that labour has begun. The cervix of a woman who has not borne a child before is, at the

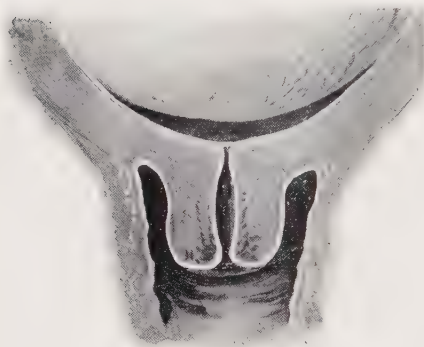


FIG. 62.

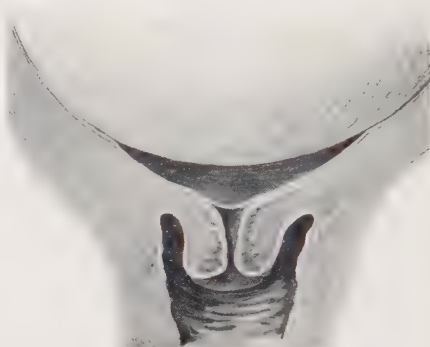


FIG. 63.

Dilatation of the cervix in labour, from above downwards. In the left figure the cervical canal is intact. In the right figure the internal os and the upper part of the canal have been dilated while the lower part of the canal is unaltered ; shortening of the cervix has occurred.



FIG. 64.

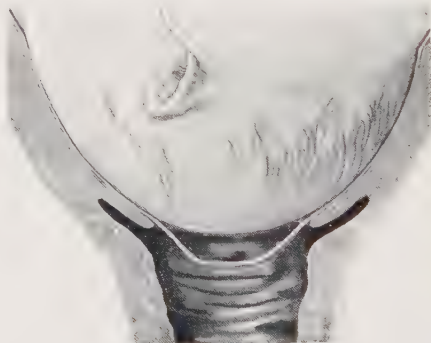


FIG. 65.

Further stages of dilatation of the cervix. In the left figure the cervix is fully taken up. In the right figure the cervix is partly dilated.

beginning of labour, a thick-walled canal at least an inch long. The circular fibres round the internal os relax when labour begins, and its edges are separated by the contraction and retraction of the longitudinal fibres of the uterus, while the lower part of the cervical canal remains at first unaltered. As the internal os is dragged open, the cervix is dilated from above downwards, becoming shorter and shorter, until at

length no projection into the vagina is left, but only a more or less thick rim at the external os, the whole cervix being taken up, and its cavity made one with the cavity of the body of the uterus. Without true shortening of the cervix it is unwise to diagnose that a primigravida is in labour (Figs. 62-65).

In women who have borne children, the external os will often admit the finger before labour has begun, and the finger-tip can sometimes be passed through the internal os. Very often the cervix has been completely taken up. In this case the projection of a small bag of membranes during a pain will be a proof that labour has begun.

3. The Show.—This is an increase of mucous discharge from the cervix, mixed with a little blood. As the internal os is pulled open, the membranes are separated from the lower uterine segment, and a variable amount of oozing of blood results. Its absence cannot be taken as a proof that labour has not begun.

4. Rupture of the Membranes.—Although this occurrence does not necessarily mean that labour has begun; when the membranes rupture spontaneously near term, it is certain that labour will begin within a short time and it may mean that labour has already begun.

The First Stage of Labour.—The effect of the contractions of the uterus is to increase the general intra-uterine pressure. At the same time the contraction and retraction of the longitudinal fibres open up the cervix. The dilatation of the internal os must cause a separation of the chorion from the decidua in its immediate neighbourhood. Thus a small bag of membranes, the separated part of the chorion with the amnion and the amniotic fluid inside it is formed, and this bag of membranes is forced into the internal os by the increase of intra-uterine pressure. The bag of membranes makes a satisfactory dilator of the cervix—a fluid wedge which is forced farther and farther into the cervix, exerting pressure on, but doing no harm to, the maternal tissues. So long as the bag of membranes remains intact neither mother nor foetus can suffer any injury from pressure. At the beginning of a pain a little more liquor amnii is forced into the bag of membranes, the head then comes down as a ball-valve and separates the liquor amnii which is left in the uterus from that which is in the bag, called respectively the hindwaters and forewaters. Normally the bag of membranes dilates the cervix until the os is about 8·7 cm. ($3\frac{1}{2}$ inches) across, and then ruptures, being no longer supported by the margins of the os. If the presenting part does not fit the lower uterine

segment closely, the bag of membranes is likely to be pressed down in an elongated form, like the distended finger of a glove, and to rupture before the os is fully dilated. This may occur with any malpresentation and with a flattened pelvis

During the first stage the foetus is moved downwards only a very little. When a certain amount of liquor amnii has left the uterus, a good-sized bag of membranes having been formed, a new form of pressure comes into play, *viz.* the foetal axis-pressure, due to the direct pressure of the uterus on the foetus. The extent to which this force acts in the first stage of labour is indirectly proportional to the amount of liquor amnii. When there is a deficiency of liquor amnii the foetal axis-pressure will come into play early. The upper pole, normally the breech, is pressed on by the fundus of the uterus, while the lower pole is pressed down on to the lower uterine segment and cervix.

During the early part of the first stage the pain is usually not very severe, and the mother should be encouraged to remain up and about. Towards the end of the first stage, however, the pains may be very distressing to the patient, recurring frequently, and, as advance is not perceptible to her, apparently doing no good. Vomiting is not uncommon towards the end of the first stage. The pains of this stage are, until near the end, purely involuntary, the patient not making use of her voluntary muscles as she does during the second or expulsive stage.

The pain in the first stage is due partly to the cramp-like pain of uterine contraction, and partly to the stretching of the cervix.

Disadvantage of Too Early Rupture of the Membranes.—In the past much has been written of the disadvantage of early rupture of the membranes but to-day it is agreed that in normal vertex presentations at least, early rupture is of little disadvantage. In some patients the membranes rupture before the onset of labour, and artificial rupture of the membranes is the most satisfactory method of inducing labour; in such cases the labour follows a normal course.

The virtue of the bag of membranes is due to the fact that while it remains intact, the rise in intra-uterine pressure is distributed equally over the foetus. This is still true in a normal case after the rupture of the membranes, except for the small part of the foetus exposed at the dilated cervix, because the well-fitting presenting part prevents much liquor from draining away. If, however, there is a malpresentation, or if labour follows an abnormal course, because the presenting part does not fill the lower segment, early rupture of the membranes may be followed by the loss of the greater part of the liquor, and the

uterus may become closely applied to the foetus, so that during contraction, it may be grasped rather than expelled. It is in these cases of malpresentation and in those in which there is a slight disproportion between the foetal head and the maternal pelvis, that the intact membranes are so advantageous. Unfortunately these are the cases in which early rupture is likely to occur. If the membranes do rupture early in such cases, the anterior lip of the cervix may become nipped between the presenting part and the pelvis, and may become swollen and oedematous, adding to the difficulties of the labour. There is also an increased risk of infection spreading up to the foetus and the cavity of the uterus especially if labour is prolonged. If most of the liquor has drained away, the foetus, the cord and the placenta may all be unduly compressed by the retraction of the uterus, so that if labour is prolonged, the foetus may die.

Disadvantages of Too Late Rupture of the Membranes.—If the membranes remain unruptured when the os is fully dilated, the onset of the expulsive pains is retarded, the cervix not receiving the pressure of the hard head which should stimulate the uterus to increased activity. The amnion, which is a tough, strong membrane, is likely to be pushed through the chorion, which is weaker and more easily torn. If the part of the amnion which forms the bag of membranes does not rupture before the head is born, it may tear higher up or may not tear at all, the head in either case being born with a bag of amnion covering it. This condition, in which the child is said to be born with a caul, may cause its death from suffocation if a doctor or nurse is not present. If the bag of membranes remains intact after full dilatation of the os, it should be ruptured by pressure with a blunt instrument during a contraction.

The Second Stage.—After the rupture of the membranes and escape of some of the liquor amnii it is not uncommon for a short pause to occur before the onset of the typical expulsive pains, the uterus, as it were, collecting itself before making more vigorous efforts. In some multiparæ, however, the child may be born almost immediately after rupture of the membranes.

There is very little descent of the foetus during the first stage. The resistance offered by the cervix and lower uterine segment has now been overcome, and the presenting part can be pushed down on to the pelvic floor, the resistance of which has now to be overcome by the downward pressure of the uterine contractions, aided by the action of voluntary muscles—the muscles of the abdominal wall and the diaphragm.

The pains of the second stage of labour are stronger and of longer duration than those of the first stage, and the intervals between them are shorter. Towards the end of the second stage each contraction may last as long as a minute or more, with intervals of 2 or 3 minutes, and at the end the contractions may be almost continuous.

The pain suffered during the second stage is often not quite so severe as that at the end of the first stage. The patient too, feels that some progress is now being made and that she can help. As the head passes through the pelvis the patient may complain of cramp in the legs due to pressure on the sacral nerves. The most acute pain is felt, in first labours, during the forcible stretching of the vulva.

The character of the pains is different from that of the pains of the first stage. The patient may cry out as the contractions come on, but she generally takes a deep breath, and then holds her breath and bears down with all the force of her expiratory muscles, often crying out again as the contraction passes off. During the height of the pain there may be expiratory groans. These expiratory or expulsive efforts are partly voluntary but largely reflex due to the presence of a foreign body in the vagina. To aid her expulsive efforts the patient will often place her feet against some fixed object, such as the bed-end, and pull on a towel tied to the same fixed point.

During a contraction the rate of the foetal heart-beat is slowed. Unless the child is beginning to suffer from the long-continued pressure, either on the placental-site circulation or on its head, or both, the heart-beat regains its normal rate between the contractions.

The presenting part is forced down with each contraction on to the pelvic floor, distending this structure and pressing it downwards. During the intervals between the contractions, however, the pelvic floor pushes the presenting part up again. Retraction now plays an important part, the cavity of the uterus remaining a little smaller after each successive contraction than it was before it, so that the progress made by each contraction is not completely lost during the succeeding interval. In a primigravida the head will be seen at the vulva for a considerable time before it can emerge. Finally, after being pushed down many times by the uterine contractions and slipping back in the intervals between them, a time comes when it remains stationary at the end of a contraction, distending the vulval orifice. This is called the crowning of the head. The next contraction generally expels the head, which emerges in a downward and forward direction. It is important for the student to realize the extent to which the head goes forward. The uterus and abdominal muscles are pressing the head mainly downwards, while the muscles of the pelvic floor are pressing upwards and forwards. The resultant of these two forces is mainly forwards.

The axis of the outlet of the bony pelvis is downwards and forwards, that of the soft parts below the bones is almost directly forwards.

As the head passes through the vulva of a primigravida the pain due to the stretching of the vulval orifice will be very severe, and will probably cause the patient to cry out, and so cease from bearing down. To some extent, this saves the perineum because it is more likely to be torn if the patient bears down hard while the head is passing through the vulval orifice.

In first labours the hymen is torn posteriorly, and the fourchette is usually lacerated.

The body of the child is generally born by the next contraction if not by the contraction which expels the head, followed by a gush of liquor amnii, mingled with blood.

The Caput Succedaneum.—That part of the child which is most in advance is free from pressure, while all the rest of the child is pressed upon. Consequently, as a result of the venous congestion, serum is exuded and an oedematous swelling forms on the scalp, superficial to the periosteum of the cranial bones and not limited to them. This is known as the caput succedaneum.

In cases in which the head has been exposed to severe and long-continued pressure the caput succedaneum may contain blood-corpuscles, as well as plasma.

The caput succedaneum, unlike the cephalhæmatoma, to be described later, does not increase in size after birth, but gradually disappears in the course of a few hours or days.

If some other part presents, *e.g.* the face or breech, a swelling will be formed over the part most in advance exactly comparable with the caput succedaneum.

Moulding.—The change in the shape of the head by which the diameters of the skull most pressed upon become diminished in size is called moulding and is brought about by pressure. The importance of moulding of the foetal head during labour can be best appreciated by observing patients with slight disproportion who deliver themselves safely. The bones of the base of the skull are incompressible, and are joined to each other in such a way that movement is not possible between them, but the bones of the vault of the skull are compressible, and the sutures allow of a certain amount of movement between the individual bones. The parietal bones and the tabular portions of the occipital and frontal bones can be bent by pressure, and when much compressed, the parietal bones override the occipital and frontal bones, and the anterior parietal bone, being less pressed on than the posterior, overrides its fellow.

The Third Stage. The uterus follows down the body of the child, and after its expulsion the fundus reaches up to a point a little below the umbilicus.

As a rule, contractions are absent for a few minutes after the expulsion of the child, the uterus, which now contains only the placenta and membranes, remaining retracted without active contractions. Sometimes, in the absence of artificial stimulation, there may not be any marked contractions for an hour. During this time, however, the hand placed lightly on the uterus will feel slight rhythmical contractions, not severe enough to be noticed by the patient. After a time, which varies very much in different cases, the placenta is expelled either into the vagina or through the vaginal orifice.

As the uterine walls become thicker and the internal surface of the uterus becomes smaller, the placental site shrinks with the rest of the internal surface until it reaches a stage when detachment must occur unless the placenta is abnormally adherent. Separation of the placenta from the uterine wall occurs in two ways: (1) a part of the placenta near its centre separates and bleeding occurs at this point. The next contraction will cause a further ring of separation followed by further bleeding during relaxation of the uterus. Thus the placenta is separated in a series of concentric rings. The centre of the placenta is gradually pushed down through the cervix with its foetal surface presenting. The placenta is delivered first, dragging the membranes behind it with the amnion now outside and the chorion inside. (2) In other patients separation of the placenta begins at its lower pole which is less well supported by the pressure of the uterus and the whole placenta is gradually driven into the cervical canal, the upper pole being the last part to leave the uterine cavity. Either the edge or the uterine surface of the placenta presents in these cases. The separation of the membranes from the uterine wall takes place through the decidua, part of which comes away attached to the chorion, while the rest remains in the uterus. During the first stage the membranes have been separated from part of the lower uterine segment. After the birth of the child the decrease in the size of the cavity results in the membranes being thrown into loose folds and attached only in places. The expulsion of the placenta normally completes the detachment of the membranes from the uterine wall. The amnion is a tough membrane, firmly attached to the root of the cord, and is certain to be dragged out by the placenta. The chorion is continuous with the edge of the placenta, but its intimate contact with the amnion is more important from the point of view of the third stage of labour.

There is generally a gush of blood, not amounting to more than a few ounces, just as the placenta is expelled. If the uterus does not

retract well after the placenta is separated from its walls, hæmorrhage occurs; but if it is well retracted, as usually happens, there is not more than a thin trickle of blood coming away after the birth of the placenta. The uterus is then felt as a hard, round ball about the size of a foetal head, the top of the uterus reaching up to about half-way between the pubes and umbilicus.

The average amount of blood lost in normal labour is about 280 c.c. (10 ounces); about 120 to 150 c.c. (4 to 5 ounces) before the birth of the placenta, and the rest with it.

Duration of Labour.—Labour in primiparæ lasts on an average 15 to 20 hours. In multiparæ, 7 to 10 hours can be taken as the average time. The first stage in primiparæ usually lasts 12 to 18 hours, the cervix taking much longer to dilate than in multiparæ. In the second stage the perineum and the orifice of the vagina offer much greater resistance in primiparæ than in multiparæ. In primiparæ over 30 years of age still greater resistance may be expected from all the soft parts, increasing with advancing years, although some primiparæ over 40 years of age have easy labours.

In some multiparæ labour may last only 2 or 3 hours. It is not very uncommon for the child to be born after two or three contractions after full dilatation of the os in multiparæ.

CHAPTER XIII

MECHANISM OF LABOUR

THERE are 3 varieties of cephalic or head presentation:—

1. Vertex presentations, when the head is flexed on the trunk.
2. Face presentations, when the head is extended on the trunk.
3. Brow presentations, when the attitude of the head is midway between flexion and extension.



FIG. 66.—FIRST POSITION OF THE VERTEX, L.O.A.

VERTEX PRESENTATIONS

Vertex presentations occur in about 96 per cent. of all cases of labour for reasons which were explained on p. 104. The back of the foetus and the occiput may lie in any position relative to the back of

the mother. Although the classical description generally describes four positions with the long axis of the head lying in one or other of the oblique diameters and the occiput either anterior or posterior, it has been shown by radiography that in the majority of cases during pregnancy the occiput lies laterally and the long axis of the head engages in the transverse diameter of the brim. When the head lies deeply in the pelvis as it generally does in primigravidaë after the 37th week its long axis will often lie in one of the oblique diameters at the onset of

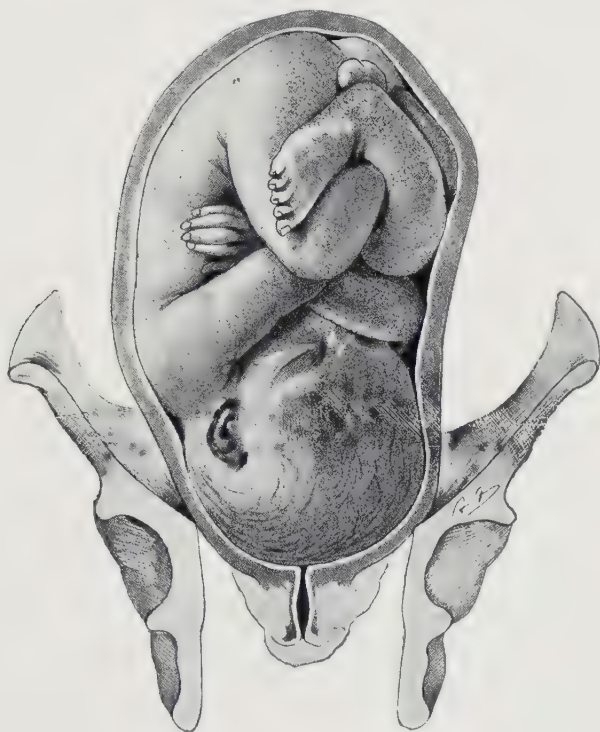


FIG. 67.—THIRD POSITION OF THE VERTEX, R.O.P.

labour. In multiparaë however, when the head generally remains above the brim until the onset of labour the lateral position of the occiput will persist. The long axis of the head will enter the brim in the transverse diameter and will often remain in that diameter until the vertex comes in contact with the pelvic floor at the end of the first stage of labour. Because of the slight rotation of the uterus there is a tendency for the occiput to lie a little anterior to the lateral position when it is in the left side and a little posterior to the mid line when it is on the right side. Because of this cases in which the occiput lies to the left will generally rotate to the front during labour. When the occiput

lies to the right, although the majority will rotate to the front there is an increased risk that it may rotate to the back.

The frequency of the various positions of the occiput will obviously differ during pregnancy, and in fact the presentation of the foetus is constantly altering, but at the onset of labour in about 40 per cent. of cases the occiput will lie in the left occipito-lateral position and in about 25 per cent. in the right occipito-lateral. The next most common positions are the left occipito-anterior and the right occipito-anterior, and the right occipito-posterior, in that order. The least common is the left occipito-posterior. Slight variations in the shape of the brim of the pelvis probably play some part in determining in which diameter the long axis of the head will lie as it passes the brim of the pelvis.

The description of the four classical positions of the occiput will now be given. The 4 positions are: 1. The left occipito-anterior, L.O.A. The occiput is directed to the left and in front. 2. The right occipito-anterior, R.O.A. The occiput is directed to the right and in front. 3. The right occipito-posterior, R.O.P. The occiput is directed to the right and behind. 4. The left occipito-posterior, L.O.P. The occiput is directed to the left and behind.

DIAGNOSIS OF THE FIRST POSITION, L.O.A.

Abdominal Examination.—The breech occupies the fundus of the uterus, the back is felt to the left and in front, the limbs are felt on the right side, and the head is felt in the pelvis or, in multiparæ, at the brim, with its most prominent part on the right. The foetal heart is best heard below and to the left of the umbilicus (Fig. 57).

Vaginal Examination.—The sagittal suture is found to be lying in the right oblique diameter of the pelvis, with the posterior fontanelle in front and to the left (Fig. 68).

The anterior fontanelle lies behind and to the right, but owing to the flexion of the head, it is too high to be felt except under an anæsthetic.

DIAGNOSIS OF THE SECOND POSITION, R.O.A.

For the diagnosis of the second position of the vertex the above paragraphs should be read with the word right substituted for left, and vice versâ; the back is felt to the right with the limbs to the left, and so on.

DIAGNOSIS OF THE THIRD POSITION, R.O.P.

Abdominal Examination.—The breech occupies the fundus; the limbs are felt over the front of the uterus; the back is found

behind and to the right, and is felt less easily than in the occipito-anterior positions. In an anterior position the resistance of the shoulder will be felt in the line between the pubes and the umbilicus. In a posterior position a definite hollow will be noticed

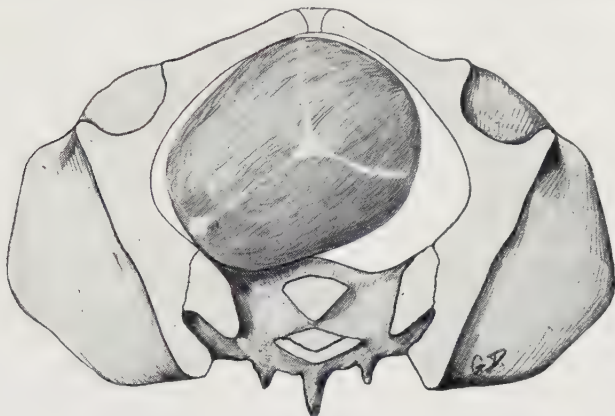


FIG. 68.

1. L.O.A.

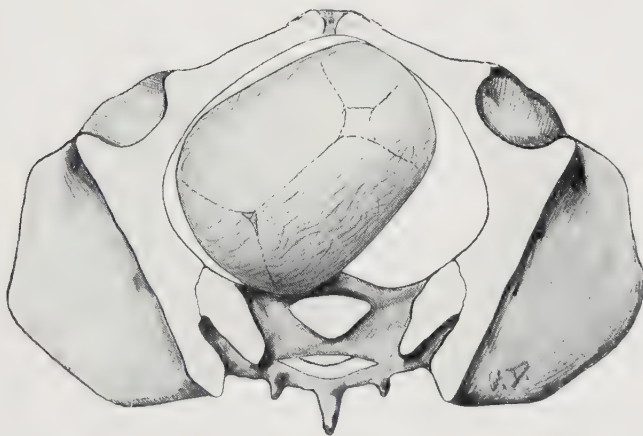


FIG. 69.

3. R.O.P.

The first and third positions of the vertex as seen from below, and as felt by the examining fingers on vaginal examination.

in this position between the head and the limbs. The head is felt at the brim of the pelvis, usually higher up than in anterior positions, with its most prominent part to the left. The foetal heart is heard best below and well out to the right of the umbilicus.

Vaginal Examination.—The sagittal suture is found to be lying in the right oblique diameter of the pelvis, with the posterior fontanelle

behind and to the right, because the head is often less well flexed in a posterior position, the anterior fontanelle may also be felt in front and to the left (Fig. 69).

DIAGNOSIS OF THE FOURTH POSITION, L.O.P.

The two preceding paragraphs should be read with substitution of the word right for left and vice versâ.

Relative Frequency.—The 1st position of the vertex, L.O.A., is the most common, occurring in about 60 per cent. of all cases of labour.

The second position is more common than the third, and the fourth position is the least common.

MECHANISM OF LABOUR

By the term mechanism is meant the series of changes in position and attitude which the presenting part has to make in its passage through the pelvis and the pelvic floor. The mechanism of labour should be studied with the pelvis and the dummy foetus, as well as by careful observation during labour.

The head is a more or less oval body which fits fairly tightly into the canal through which it is pushed. The longest diameter of the pelvis is transverse at the inlet and antero-posterior at the outlet. At the outlet the pelvic floor offers resistance to the head on both sides and behind, while it leaves a free space in front. Consequently the head, which enters the pelvis in the transverse or one of the oblique diameters, does not maintain the same position throughout its passage, but undergoes some rotation and also some change in its attitude. If the head and the pelvis are both of normal size, the soft parts have more to do with the mechanism of labour than the pelvic bones.

MECHANISM. FIRST VERTEX, L.O.A.

While the head is descending it makes four movements :—

- | | |
|---------------|-----------------------|
| 1. Flexion, | 2. Internal rotation, |
| 3. Extension, | 4. External rotation. |

Flexion.—The head is flexed before labour begins, as part of the general attitude of flexion that occurs under normal conditions. If this flexion of the head is not complete before the forces of labour come into play it becomes complete—*i.e.* the head becomes flexed until the chin meets the chest—as the head is pressed down on to the lower uterine segment and cervix. The reasons for this complete flexion, by means of which the occiput descends more than the forehead, are 1. The shape of the head; 2. The head lever,

The Shape of the Head.—(a) The occiput and forehead are pressed against the sides of the canal. The slope at the posterior end of the head is much steeper than is that at the anterior end, consequently the occiput can descend more easily, with less friction, than can the forehead.

(b) Any ovoid body being pushed through a tube will tend to adapt its long diameter to the long axis of the tube. When the head is completely flexed its longest diameter, the vertexo-mental, is lying in the long axis of the canal, while the shortest longitudinal diameter, the suboccipito-bregmatic, is lying across the canal.

The Head Lever.—When the breech is pressed on by the fundus of the uterus, the foetus being subjected to foetal-axis pressure, the head lever comes into play. The occipito-spinal joint is nearer to the occiput than to the forehead, so the head can be looked on as being a lever with a short posterior arm and a long anterior arm. As the foetus is pressed downwards the long anterior arm meets with more resistance, and so is more retarded than the short posterior arm—i.e. the forehead does not descend so deeply as does the occiput. The importance of the head lever has been exaggerated. There is more room in the front of the pelvis than at the back, therefore, whatever part of the head is in front will descend more readily. If the occiput is in front flexion is thus favoured, as the greater resistance is posterior.

When the head is engaged in the brim, the sagittal suture is found to be lying in the right oblique diameter of the pelvis. The effect of complete flexion is to bring the posterior fontanelle, which lies in front and to the left, to a lower level than that of the anterior fontanelle, which lies to the right and behind.

Internal Rotation.—In the second stage of labour the head is pressed further downwards, the occiput, being lower than the forehead, first meets the resistance of the pelvic floor, which can be looked on as a sloping gutter between the two levatores ani leading to a free space in front under the symphysis pubis. As the occiput is pushed down, it rotates away from the resistance of the pelvic floor, moving forwards through one-eighth of a circle, along the left side of the pelvis, towards the free space under the pubic arch. The shape of the pelvis and the curvature of its axis may play some part. The largest diameter of the pelvis is transverse at the inlet and antero-posterior at the outlet and the long axis of the head will tend to rotate from the transverse to the antero-posterior as it descends. Because the axis of the pelvis is curved, it has been suggested that to pass round the curve easily the foetus will tend to rotate, because with a well flexed head the foetus

is a relatively rigid structure except for the movement of extension of the head on the trunk. The head thus comes to lie with the sagittal suture in the antero-posterior diameter of the pelvis, the occiput and posterior fontanelle in front below the pubic arch, the forehead and anterior fontanelle behind in the hollow of the sacrum, the nape of the neck being against the back of the symphysis pubis, the chin still in contact with the chest.

Extension.—The head is now acted on by two forces. The uterus and abdominal muscles are pressing it downwards, while the muscles of the pelvic floor are pressing it upwards and forwards.

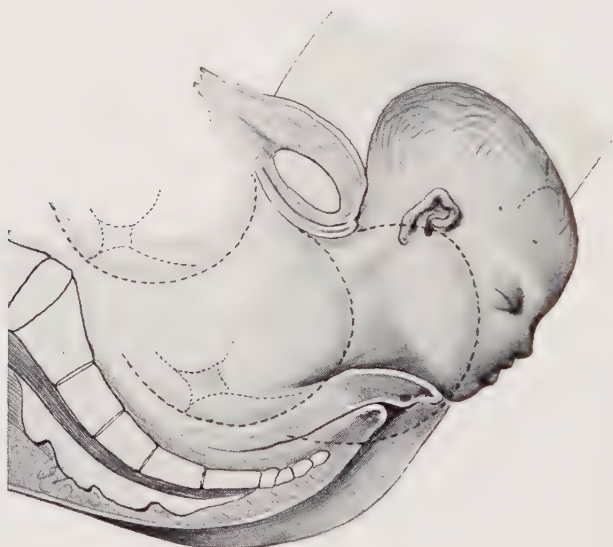


FIG. 70.—EXTENSION OF THE HEAD.

The occiput is seen to move forwards and upwards over the symphysis as the head emerges, the face and chin escaping from under the perineum.

The resultant of these forces acts in a forward direction—the downward and upward pressures counterbalance one another, and the head has to go forwards. It cannot go forward as a whole because the nape of the neck is fixed against the symphysis pubis. The only way in which the head can go forwards, as it must to follow the curve of the birth-canal, is by a movement of extension, the chin leaving the chest, and the occiput escaping under the pubic arch. The occiput is free already, and the vertex stretches the vaginal outlet until the head can emerge, the vertex, forehead, face, and chin successively gliding forward from under the perineum (Fig. 70).

External Rotation.—There are now two movements: 1. Restitution or untwisting; 2. External rotation.

Restitution.—As the head descends with its suboccipito-frontal diameter in the right oblique diameter of the pelvis the shoulders enter the pelvis in the left oblique diameter. When internal rotation of the head takes place the head is twisted a little on the shoulders. As soon as it is completely born it resumes its natural position with regard to the shoulders, turning with the occiput towards the mother's left thigh. This movement, which is performed as soon



FIG. 71.—THE FIRST MOVEMENT OF EXTERNAL ROTATION.

The head is seen to have rotated so that the face looks to the right instead of backwards as it did at the moment that the head was born.

as the head is free, sometimes almost with a jerk, is called restitution, because by it the neck becomes untwisted and the head is restored to its natural relation to the shoulders.

Second Movement: External Rotation.—As the shoulders descend the right and anterior, being the lower, meets the resistance of the pelvic floor before the left, and so rotates to the free space in front, as did the occiput. The shoulders now occupy the antero-posterior diameter of the pelvis. As they rotate the head rotates with them, the occiput making a further movement of one-eighth of a circle towards the mother's left thigh. The head now lies with the face to the right and the occiput to the left (Fig. 71).

It will be noticed that the internal and external rotations are in the same direction, the back of the head being on the same side at the end of the second stage of labour as it was at the beginning.

The shoulders then emerge, the right one escaping under the pubic arch, while the left slides over the perineum, followed by the rest of the body, which is usually born without difficulty, being smaller than either the head or shoulders. The arms are usually folded on the chest, with the hands near the chin.

SECOND VERTEX, R.O.A.

The occiput lies to the right and in front. In its internal rotation it travels along the anterior part of the right side of the pelvis to reach the middle line. Extension takes place as above. The shoulders enter in the right oblique diameter of the pelvis. When the head is free the occiput turns towards the mother's right thigh. The left shoulder rotates to the front, and the head makes a further rotation with the occiput towards the mother's right thigh.

THIRD AND FOURTH VERTEX, R.O.P. AND L.O.P.

The mechanism in the occipito-posterior positions depends on whether

1. The head is well flexed ; or
2. The head is incompletely flexed.

The Head is well flexed.

Mechanism.—If the head is well flexed the occiput is in advance when the head meets the resistance of the pelvic floor. To escape from this resistance the occiput makes a long rotation, through three eighths of a circle, to reach the free space under the pubic arch.

In the *third position* the occiput lies behind and to the right. It rotates along the right side of the pelvis to reach the front, the shoulders rotating with it from the left oblique diameter of the pelvis into the right oblique. From this point the mechanism is the same as that of the second vertex position.

In the *fourth position* the occiput makes a long rotation along the left side of the pelvis. The occiput rotates towards the mother's left thigh as soon as the head is born, the right shoulder comes to the front, the final stages being just the same as when the head lies in the first position.

When asked why some cases of occipito-posterior positions cause difficulty, many students reply that the reason is that the occiput has to make a long rotation and that, therefore, labour is prolonged. This is not correct. If the head is fully flexed, as it must be for the long rotation to occur, there is no delay in the labour and no difficulty. The cause of difficulty is that in some cases flexion is incomplete, and, therefore, the normal long rotation does not occur.

The Head is incompletely flexed.—In some cases flexion is incomplete when the head lies in the third or fourth position. There are two reasons for this incomplete flexion :—

(a) When the back of the foetus lies against the front of the uterus, with the spine flexed, the concavity of the foetal body fits the convexity of the maternal spine. The tighter the abdominal muscles of the mother the more complete will flexion be. When, however, the back of the foetus lies against the maternal spine the two convexities are in contact with one another. The foetal spine has then a tendency to become less completely flexed, so as to fit the maternal convexity better. This causes some extension of the head.

(b) When the occiput lies to the front, with the sagittal suture in one of the oblique diameters of the pelvis, the biparietal diameter, the largest transverse diameter of the head, lies in the other oblique diameter. When the occiput occupies the posterior part of one of the oblique diameters the biparietal diameter does not lie in the other oblique, but in a smaller diameter (the sacro-cotyloid), which is encroached on by the promontory of the sacrum. When the head is pressed down into the pelvis in this position, the biparietal diameter is hindered from descending if the pelvis is small or the head large, and so the forepart of the head descends more easily than the occiput, and the head enters the pelvis incompletely flexed. While the head is above the brim extension may go on until a face presentation is produced, but if the head enters the pelvis incompletely flexed further extension is impossible, as this would cause a still larger diameter to engage in the pelvis, and the size of the pelvis would not allow this to occur.

If flexion is incomplete the occipito-frontal diameter of the head, which measures 11·25 cm. ($4\frac{1}{2}$ inches), has to pass through the pelvis, instead of the suboccipito-frontal, which measures 10 cm. (4 inches), or the suboccipito-bregmatic, which measures 9·4 cm. ($3\frac{3}{4}$ inches). It is this and the fact that, sometimes, neither the occiput nor the forehead is sufficiently in advance to influence rotation that explain why some cases of occipito-posterior positions cause difficult and prolonged labour (see Fig. 38).

Mechanism in Occipito-posterior Positions with Incomplete Flexion.—When the head is pressed down on to the pelvic floor the occiput is not the lowest part of the head, not having descended so much as it would have done if flexion were complete.

The forehead is now as low as the occiput, and being at the anterior end of the oblique diameter of the pelvis, meets the resistance of the pelvic floor before the occiput. The forehead, therefore, goes to the front, to the free space under the pubic

arch, rotating through one-eighth of a circle, while the occiput makes a short rotation backwards into the hollow of the sacrum. It is important for the student to understand why the occiput rotates into the hollow of the sacrum. The occiput goes to the back simply because the forehead goes to the front, the forehead being the important factor in the internal rotation because it is lower than the occiput, and, therefore, meets the resistance of the pelvic floor first. If the head is normal it may be born with the face towards the posterior surface of the symphysis pubis. The root of the child's nose is pressed against the bone and becomes fixed, and the head rotates about this fixed point. The vertex is born by flexion and followed by the occiput. As soon as the occiput is born the head extends, the face and chin emerging from under the pubic arch. The vulval orifice is stretched by the occipito-frontal instead of the suboccipito-frontal diameter with a difference in size of $\frac{3}{4}$ of an inch, and a severe perineal tear may occur.

In some cases the head becomes arrested with its long axis in the transverse diameter of the pelvis, the degree of extension being such that neither the occiput nor the forehead is sufficiently in advance to influence rotation. This is described as deep transverse arrest of the head and calls for interference, which will be described later.

CHAPTER XIV

MANAGEMENT OF LABOUR

THE majority of patients nowadays are confined in hospital. As soon as the patient is admitted, her antenatal record should be reviewed to discover whether there have been any abnormal features during pregnancy, she should be examined to confirm that the presentation remains satisfactory. Rarely the patient will not have had any antenatal supervision. In this case a complete examination will be necessary.

If the patient is to be delivered in her own home the doctor should go to see the patient as soon as labour begins. In domiciliary cases a supply of sterile towels, dressings, antiseptics, etc., will generally have been arranged by the nurse, but the doctor should check that everything necessary is present.

Asepsis.—Although the dangers of infection have been much reduced by the use of antibiotics, it is still very important to minimize the risk of introducing infection to the genital tract during labour and the puerperium. A sterile gown, gloves, and an efficient mask to prevent droplet infection, must be worn by everyone in contact with the patient in labour. Vaginal examinations should be limited as far as possible.

The Arrangement of the Lying-in Room and the Bed.—The room should be cleared of all unnecessary furniture, so as to leave ample room for a table for instruments and dressings, a small table for the anaesthetist and a table for basins and lotions. The room should be warm and a good light in a position most suitable for the accoucheur is absolutely necessary. A single bed, if it is possible of a height of 3 feet, should always be used for the confinement, as it facilitates the management of the mother during the labour and the nursing of her afterwards. A fairly unyielding mattress is necessary for the labour; any sagging of the bed tends to make delivery more difficult for the accoucheur. A mackintosh sheet is laid over the mattress, then a blanket and bedsheet with a second mackintosh sheet or batiste over these. The upper mackintosh should overhang the side of the bed on which delivery will be effected, so that blood or liquor can drain into a receiver below. A large sterile pad of absorbent wool, such as Gamgee tissue, should be placed immediately under the mother's hips and changed when necessary.

The Patient's Dress.—The best costume consists of a nightgown, long woollen stockings and a bed-jacket. During the second and third stages the nightgown is pinned up towards the armpits and so kept clean and out of the way. The vulva, thighs and buttocks should be covered with sterile towels.

Examination of the Patient.—By abdominal palpation and auscultation the presentation and position are diagnosed, and also the relation of the presenting part to the brim of the pelvis whether it has entered or is still above it. If the presenting part has not yet entered the brim, an attempt must be made to find out whether or not it can be made to enter. In the majority of patients it is only a matter of confirming facts which had been made out and recorded in the antenatal period. The doctor makes a pelvic examination to investigate the size of the os, and then decides from the degree of dilatation, the strength and frequency of pains, and the fact that the bag of membranes is still unruptured or not, whether he must stay or can safely leave the patient temporarily. Only experience and judgment of each case on its merits, will teach the student when he can safely leave. If the os is not more than half dilated in a primipara and there are no unusual features about the case, he can go away for a time ; but it is not safe to leave a multipara at this stage. It is far better for the patient's safety and for the doctor's reputation that he should stay for some hours unnecessarily than that he should be away when the child is born. If the patient is nervous, especially in a first labour, the doctor should not stay in her room all the time, but remain near at hand.

MANAGEMENT OF THE FIRST STAGE

When the first stage is commencing an enema of soap and water should be given. The patient may have a hot bath, after which the vulva and surrounding skin are thoroughly cleansed and shaved.

If an expectant mother is given some idea in simple language of what to expect in each stage, a great deal of the apprehension from which so many women suffer can be removed before labour begins. If she is told that the first stage is the long one, and one in which she herself is not likely to appreciate much progress, it will be much more easy to reassure her and maintain her patience once labour has started. It is unwise to forecast the probable duration of the labour.

If the head has engaged there is no need for the patient to stay in bed; there is a distinct advantage in her walking about, resting on a chair or sofa when necessary. The weight of the liquor amnii and foetus helps in the dilatation of the cervix, and the pressure

on the lower uterine segment and cervix stimulates the uterus to contract. During the first stage the patient is not usually conscious of any progress, and is more likely to be discouraged, nervous, fractious, and clamorous for assistance or relief if she is kept lying down than if she is allowed to walk about. In all cases of malpresentation, the patient must be kept in bed during the first stage to diminish the likelihood of early rupture of the membranes.



FIG. 72.—FULL BLADDER DURING LABOUR.

The pain during the early part of the first stage of labour is usually not very severe, though in primiparæ it may cause a good deal of distress and sometimes vomiting, when the cervix is beginning to dilate. Towards the end of the first stage the pains may become very distressing and in a primipara it is usual to give an analgesic such as pethidine when the cervix is about three-fifths dilated (see Chapter XXXIX). It is wrong to tell a woman to bear down during this stage. Bearing down before the dilatation of the os is complete is useless, and the patient's strength is exhausted by such fruitless efforts. Many women experience a feeling of relief and comfort when the lower part of the back is pressed on or rubbed during a pain.

There is usually a frequent desire to pass water during this stage. If the bladder becomes full and the patient cannot empty it, a soft catheter must be passed, as a full bladder has an inhibiting effect on the uterine contractions.

In a normal case the patient should be encouraged to take light food

during the first stage. If, however, there is any likelihood that the patient may need a general anæsthetic towards the end of labour it is better to withhold food so as to reduce the risk of vomiting during induction of anæsthesia and the resultant risk of inhalation asphyxia.

Gas and air or trilene analgesia may be necessary towards the end of the first stage if the patient becomes distressed.

MANAGEMENT OF THE SECOND STAGE

During the second stage the patient should be in bed, and the nurse or medical practitioner should stay with her. During this stage it does not matter in what position the patient lies. Some seem to be able to use their voluntary muscles better if they are lying on their backs with the knees drawn up. Others prefer to lie on one or other side drawing the knees up as the contraction begins. If the second stage is prolonged it may be necessary to pass a catheter if the patient cannot pass urine. When the head begins to show at the vulva it must be decided whether the patient is to be delivered on her back or on her side. In domiciliary practice where little help is available the left lateral position is probably the better and most obstetricians consider that it is easier to control the birth of the head in this position. In hospital practice where plenty of assistance is usually available most patients are delivered on their backs. It is easier to maintain a good aseptic technique in this position and in many patients the uterine contractions seem to be better sustained.

As each uterine contraction develops and pushes the head on to the pelvic floor the expulsive reflex will be stimulated and the patient will generally take a deep breath, hold it, and strain down. In a first labour it may be helpful to give the patient a little instruction at this stage and she should be encouraged to relax the muscles of the pelvic floor at the time of the contraction.

The progress of the descent of the head can generally be judged by watching the perineal region. At first there will be a slight general bulge of the perineum as the patient strains. As soon as the head is on the perineum the anus will begin to open with each contraction and soon after this, the caput will be seen at the vulva at the height of each contraction. Between each contraction the elastic tone of the pelvic muscles will return the head to the cavity of the pelvis.

With each contraction the vulval outlet and whole perineal body will become more and more stretched until the head is so low that the occiput can begin to slip forwards under the pubic arch. The head is now said to be crowned and it will no longer go back when the contraction passes off and delivery is imminent.

Care of the Perineum.—If the contractions are strong and delivery is left entirely to nature, laceration of the perineum may be caused during the birth of the head. A tear of the fourchette in a primipara is sometimes called an inevitable laceration, but even this is not absolutely inevitable. A tear of the perineum begins, as a rule, in the posterior vaginal wall, and if the perineum is distended further the skin will begin to tear. Even when the head is delivered without laceration, the birth of the shoulders may damage the perineum, and if the head has produced a small laceration the birth of the shoulders is likely to increase the damage.

The management of the delivery of the head may be summed up under the following headings:—

1. Do not let the head be born too quickly.
2. Keep the head flexed until the occiput has escaped under the pubic arch.
3. If possible, do not let the head be born at the height of a contraction.

As soon as the head begins to appear at the vulva, some degree of anæsthesia is generally desirable. In domiciliary practice a trilene inhaler is generally effective, but it is a great advantage to have an anæsthetist present, so that he can deepen the degree of anæsthesia towards the end of delivery if necessary, see Chap. XXXIX.

The head will be seen to show at the vulva with each contraction of the uterus, and will disappear between pains. Gradually the amount showing will increase until eventually the head does not return when the uterus relaxes. This indicates that the greatest diameter of the head has now passed under the symphysis pubis and through the pelvic floor; the head is now said to be crowned.

During this stage the accoucheur should be ready to control the head if he thinks there is any risk of its being born suddenly, and to keep it flexed until the largest diameter has passed the outlet. Once the head is crowned the patient should be prevented from bearing down by deepening the anæsthesia if possible, or by encouraging her to breathe deeply or cry out if she is still conscious. The head may now be delivered carefully by making pressure on the fore part of the head by a finger on either side of the rectum, pushing the head forwards slowly, easing the sides of the vulval orifice over the parietal eminences before the head is allowed to extend and complete its delivery. As a rule, the head can be coaxed out in this way with the minimal amount of laceration of the maternal tissues (Fig. 73).

If extension of the head begins before the occiput is free under the pubic arch and before the biparietal diameter has passed through the vulval orifice, a larger diameter than the suboccipito-frontal will

distend the vulva and a tear may result. The fact that the head has become crowned gradually does not ensure freedom from perineal rupture should the head be expelled suddenly and rapidly. It is very important that the head should be born gradually and in the interval between pains.

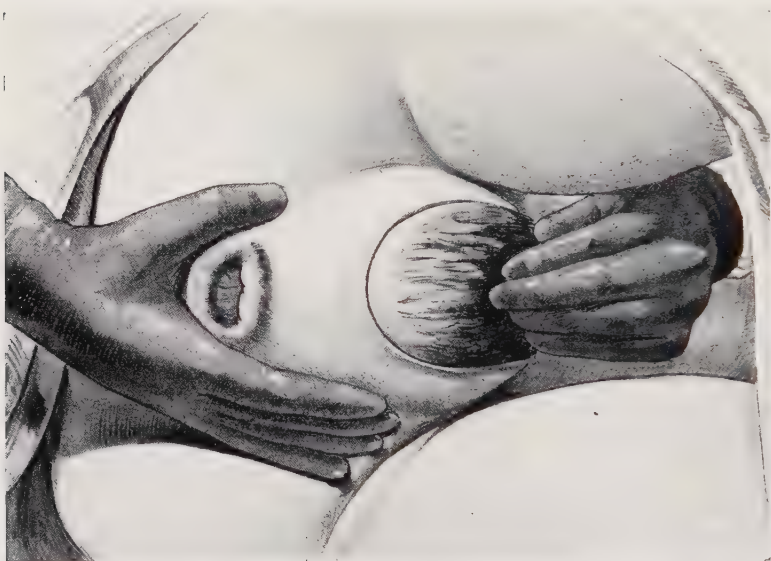


FIG. 73.—CARE OF THE PERINEUM.

The left hand is preventing sudden expulsion of the head, while the fingers and thumb of the right hand are gently helping the head forwards by pressure on each side of the anus. This pressure is exerted in an interval between the pains. Towels have been omitted for the sake of clearness.

It is quite useless for the accoucheur to attempt to hold the head back against the whole strength of the mother, and attempts to do so may cause an intracranial injury to the fœtus. Pressing the head forwards too forcibly may injure the anterior part of the vulva, bruising the urethra against the symphysis pubis, and may even cause severe hæmorrhage from the vascular tissues round the clitoris. In patients in whom the head has emerged without causing laceration of the perineum, a tear may occur during birth of the shoulders.

Episiotomy, the practice of making an incision in the perineal body is to be advised in certain cases (see page 568).

The posterior vaginal wall and perineum must always be examined carefully after the end of the second stage, and any laceration beyond the most trifling repaired by sutures. This examination can be made only after widely separating the labia in a good light,

with the patient on her back. It is far more blameworthy to neglect a tear than to allow it to occur.

As soon as the face appears, before the eyes are opened, the eyelids and surrounding skin are swabbed with cotton-wool, and then with a weak antiseptic such as boracic acid solution. If there is any suspicion that the mother is suffering from gonorrhœa, the treatment described on page 292 should be carried out. Directly the head is born a finger is inserted to feel whether a loop of cord is round the neck or not. If it is, the loop should be slipped over the head or, if this cannot be done, over the shoulders. If the loop cannot be slipped either way, the cord should be clamped with two pairs of artery-forceps and divided between them.

The shoulders usually follow with the next pain after the birth of the head, the anterior shoulder being allowed to be born before the posterior. The perineum may be torn if both shoulders are allowed to be born simultaneously.

The rest of the body quickly follows, the right hand guiding it forwards and laying it on the bed while the left hand follows the uterus down.

As soon as the child is delivered it should be held with its head downwards so that any mucus or liquor in the mouth or pharynx may run out. The mouth and pharynx should be sucked clear with a mucus extractor. A healthy baby breathes very soon after it is born, if it fails to do so, it should be treated as directed in Chapter XLVII.

Extraction of the Shoulders.—If the shoulders do not descend after the birth of the head, the mother should be exhorted to bear down. If the shoulders still do not move, and the child's face is getting blue, their birth must be assisted. If the shoulders have not rotated into the antero-posterior diameter they must be rotated by digital pressure. If there is still delay after rotation of the shoulders attempts must be made to free the anterior shoulder by gently pulling the head backwards, towards the perineum. Once the anterior shoulder has come past the symphysis the posterior can usually be delivered easily by pulling the head forwards so that the posterior shoulder does not injure the perineum. As little force as possible should be used in this manœuvre for injury to the cervical nerves and sternomastoid muscle may result if undue force is used. The amount of force necessary can be reduced by asking the mother to bear down or, if she can no longer co-operate, by getting an assistant to push on the fundus of the uterus at the same time. If this fails it may be necessary to make traction in the axilla but this will be considered under impacted shoulders.

Moulding of the Head in Vertex Delivery.—In occipito-anterior positions the greatest squeeze is exerted on the suboccipito-frontal diameter, consequently this diameter is diminished while the diameter at right angles to it, *viz.* the vertico-mental, is increased in size. Change cannot take place in the shape of the lower jaw, but the head is elongated in an upward and backward direction.



FIG. 74.—MOULDING OF THE HEAD IN OCCIPITO-ANTERIOR POSITIONS.

The dotted outline shows the shape of the head before moulding. The suboccipito-frontal or suboccipito-bregmatic diameter is compressed, while the mento-vertical diameter is increased in length.

Separation of the Child.—The cord should not be tied until the child has cried vigorously, the pulsation has ceased except in the last few inches from the umbilicus, and the umbilical vein has collapsed. If it is tied immediately, the child is deprived of 60 or 90 c.c. (2 or 3 ounces) of blood which should have been drawn out of the placenta by the expansion of the lungs. As these 2 or 3 ounces correspond to 1·14 or 1·7 litres (2 or 3 pints) in an adult, the importance of waiting a few minutes before tying the cord is evident. The cord should be tied about 7·5 cm. (3 inches) from the umbilicus, a reef-knot being used, care being taken that the umbilicus is not pulled on during the tying of the ligature. It is not necessary to tie a second ligature (except in the case of twins, Chapter XXV), as the mother does not bleed from the cord, only a few drachms of foetal blood oozing from the cut end. It is usual, however, to tie two ligatures, and cut between them, to prevent this slight escape of blood into the bed. The ligature generally consists of three or four strands of packthread tied into a knot at each end. It should be boiled and left in the boiled water or some antiseptic solution until wanted.

MANAGEMENT OF THE THIRD STAGE

The third stage of labour is a natural and physiological process; in a normal delivery the uterus will generally rest for a few minutes after the delivery of the baby. Regular contractions of the uterus soon begin again, and a few contractions will suffice to separate the placenta from its attachment to the uterine wall and push it into the vagina. The mother will become aware of its presence on the pelvic floor, and by straining, expel it through the vulva. While the placenta is separating there may be a slight trickle of blood and a few ounces of blood will be expelled with the placenta: the total amount lost should not exceed 8 to 10 ounces.



FIG. 75.—THIRD STAGE OF LABOUR.

The placenta is still in the uterus.

The danger of this stage of labour is that the amount of blood lost may be excessive. If the blood runs out of the vulva it will, of course, be immediately apparent. Sometimes, however, the blood may remain in the uterus distending it, or in the vagina pushing the uterus upwards, and the patient may lose a dangerous amount before it is obvious to an unskilled observer.

In a normal case the management of the third stage is concerned wholly with observing that the separation and expulsion of the placenta is following a physiological course and that bleeding is not excessive.

It is most important that nothing should be done to interfere with the normal action of the uterus. If it is prematurely stimulated to contract, the placenta may be partially separated, and excessive bleeding will result. It is essential, however, that the technique adopted shall ensure that no appreciable amount of blood shall accumulate in the uterus or vagina.

The third stage is best conducted with the mother lying on her back. In the most commonly used technique, the ulnar border of the left hand is laid gently on the abdomen so that the upper limit of the uterus can just be felt. After a few minutes the uterus will be felt to contract, and relax again; when the placenta leaves the uterus and passes into the vagina, the uterus will be felt to become smaller and rounder, and the fundus will rise to the level of the umbilicus. If the uterus or the vagina is becoming distended with blood, the fundus will begin to rise, and the treatment advised for post-partum hæmorrhage should be given (Chapter XXXVI).

No-Touch Technique.—As there is some risk of prematurely stimulating the uterus by placing a hand on the fundus, in some clinics the third stage is conducted by observation alone.

In a thin patient it is quite easy to see the level of the fundus, to observe the contractions of the uterus and to watch it rise up as the placenta is expelled into the vagina. If bleeding is occurring, the increase in the size of the uterus can also be observed. If, however, the patient is obese, it is difficult or impossible to observe the size of the uterus with accuracy, especially when contractions are absent.

Signs which show that the Placenta has been Expelled into the Vagina.

1. The cord moves down. This sign is most to be relied upon if a ligature has been tied close to the vulva after the slack of the cord has been pulled out of the vagina. In a case of doubt the fundus may be gently pushed down. If the extra length of cord expressed does not return on letting the fundus rise again, the placenta has been separated.

2. The uterus rises up, and feels smaller, harder, rounder and more movable. It is now perched on the placenta, and so the fundus reaches to the level of or just above the umbilicus.

3. There is frequently a little gush of blood when the placenta leaves the uterus.

Now is the time for expulsion. When the uterus contracts again the patient should be encouraged to bear down and she will generally be able to expel the placenta herself. If she fails to do so the accoucheur

grasps the uterus with his left hand, and waits for a contraction ; then using the contracted uterus as a plunger to expel the placenta from the vagina, he presses it downwards and backwards gently and steadily. As the placenta comes out of the vulva it is received in the right hand, and gently drawn away from the mother. In some clinics traction on the cord is advocated as an alternative method of assisting at this stage. Providing the uterus is contracting and the placenta

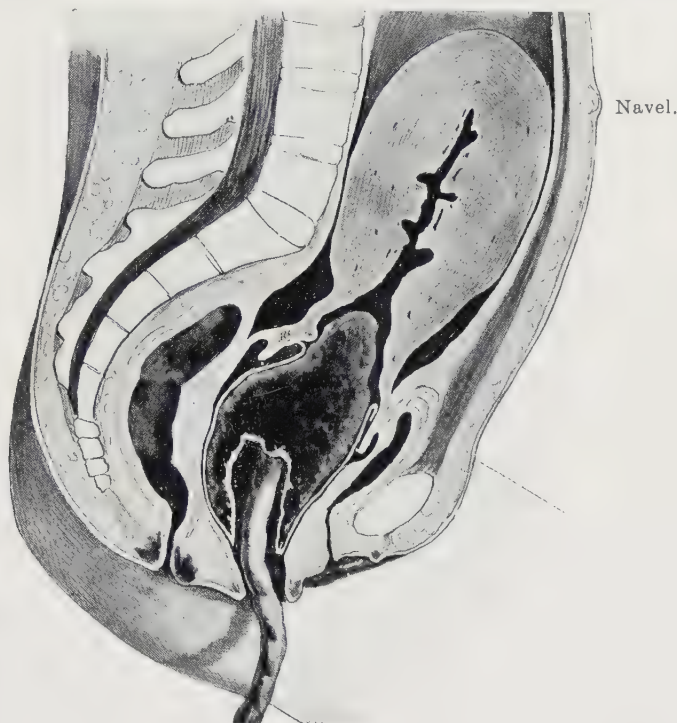


FIG. 76.—THIRD STAGE OF LABOUR.

The placenta has been expelled into the vagina, and the uterus, perched on the placenta, has risen to a higher level than it reaches in Fig. 75.

lies in the vagina this is a good method. The objection to this method is that if the placenta is in the relaxed uterus, traction may cause acute inversion of the uterus, and experience shows that it is not always easy to be sure that the placenta is in fact in the vagina. If the third stage has been left to nature, the membranes generally slip out after the placenta. If, however, they do not come away with gentle traction on the placenta, they should be taken between the finger and thumb and very gently pulled. The last parts to be separated then glide out. The left hand must still be kept on the uterus until it is certain that it

is well retracted and not inclined to bleed. At the end of the third stage of labour, when the uterus is empty and retracted, the fundus reaches halfway between the umbilicus and the pubes (Fig. 77). A few hours later the fundus reaches 14 cm. ($5\frac{1}{4}$ inches) above the pubes owing to the recovery of the pelvic floor and of the tone of the lower uterine segment which follows labour.



FIG. 77.—THE END OF THE THIRD STAGE OF LABOUR.

The uterus is empty, contracted and retracted, and lies at a much lower level in the abdomen owing to the collapse of the lower uterine segment.

[Diagrammatic].

The Use of Ergot in the Third Stage. There is good evidence that by giving ergot at the time of the birth of the baby or immediately after its birth, the amount of blood lost in the third stage is reduced and there is much less risk of postpartum hæmorrhage. Ergot produces a prolonged contraction of the uterus and cervix without periods of relaxation, so there is some risk that the placenta may be grasped in the uterus or cervix before it can be expelled to the vagina. While the uterus is contracting there is not likely to be any excessive bleeding, but there is no doubt that giving ergot before the placenta has left the uterus, slightly increases the number of cases in which manual removal of the placenta becomes necessary. Manual removal performed by a skilled obstetrician, under good conditions, with a skilled anæsthetist, is associated with very little risk, but under less satisfactory conditions it can be a dangerous proceeding.

Opinions differ as to when the ergot should be given. It may be given intramuscularly or intravenously ; as soon as the baby is born, after the birth of the head, or as soon as the head is crowned. In the face of such variations of teaching in different clinics we suggest that in a normal case an intra-muscular injection of ergometrine 0.5 mg. immediately the baby is born is a safe method. If the patient has had an anæsthetic for delivery it is probably wiser to give an intravenous injection of ergometrine 0.3 mg. as soon as the head is crowned and to deliver the placenta by cord traction as soon as the uterus contracts.

In domestic practice if the placenta is retained after giving ergot providing there is no bleeding there is usually plenty of time to send for the flying squad. It is generally not safe to transfer the patient to hospital as there is some risk that severe bleeding may begin at any time. If the patient must be transferred to hospital because no help is available then the practitioner should go with her in the ambulance.

Examination of the Perineum.—The vulval outlet must be examined carefully for lacerations. They are a source of danger during the puerperium, so any laceration more than a minute one must be sutured as described on page 445.

Vaginal and vulval lacerations seldom cause much bleeding unless they involve the tissues round the clitoris or varicose veins, when the bleeding may be severe.

Examination of the Placenta and Membranes.—The placenta and membranes must always be thoroughly examined as soon as possible. If the membranes have been inverted during birth, so that the amnion is on the outer side, as commonly happens, the placenta must be gently pushed out through the hole in the membranes, so that its maternal surface can be examined. This is best done by placing the placenta on the palms of both hands, maternal surface upwards. If there is much adherent clot it should be removed. The maternal surface will be seen to be marked by numerous furrows, or sulci, dividing the placenta into lobes. When the surface is made roughly concave, all these lobes should fit into one another. If the placenta is torn, but complete, it will be seen that the sides of the tear meet without any tissue being missing. If, however, any part is retained, a gap will be seen which cannot be filled up completely by making the surface concave.

Having examined the maternal surface of the placenta, the next step is to examine the membranes. These should form a bag, complete except for the hole through which the child passed. The amnion and chorion should be gently separated from one another, and each

examined separately. Some care is generally necessary in doing this until the edge of the placenta is reached, but the amnion can be easily separated from the placenta right up to the insertion of the cord.

The amnion is a tough, thick, translucent membrane. A portion of it is not likely to be retained, because it is not attached to the uterus. The chorion, on the other hand, is attached to the decidua, and so it is not uncommon for portions of it to remain behind. It should form a bag, and should be attached all round to the edge of the placenta. If chorion is missing from any part of it, a careful search must be made to ascertain whether the membrane has simply been torn at this point, or whether part of it has been torn off and retained in the uterus. A blood-vessel may be found running off the placenta on to the chorion, and returning to the placenta, a little further along.

A more important condition is that in which two blood-vessels, an artery and a vein, run off the edge of the placenta, going to a small detached island of placental tissue called a succenturiate placenta. If this has come away, together with the main placenta, it will be plainly seen. If it is retained, there must be a hole in the chorion corresponding to it, and a pair of vessels torn through at the edge of the hole. Succenturiate placentæ are not very common, but the possibility of their occurrence should never be forgotten in an examination of the placenta, as a careless examination would fail to reveal the fact that such an island of placental tissue had been retained. They are found most commonly in association with cases of placenta prævia.

The chorion, when separated from the amnion, is found to be friable and is not translucent. On its uterine surface are seen fragments of soft reddish tissue, the decidua. The reason why such a careful examination is important is that if a piece of placenta is retained it may cause post-partum hæmorrhage, subsequently causing subinvolution of the uterus and sepsis. If, however, a piece of membrane is retained within the uterus, be it large or small, amnion or chorion, or both, it will not cause any complications and will be expelled by uterine contractions within 2 or 3 days. It is never necessary to explore the uterus to remove a piece of membrane.

CHAPTER XV

THE PUERPERIUM

THE puerperium is the time following labour during which the pelvic organs return approximately to their condition before pregnancy. Some of the anatomical features of nulliparity are never recovered as a result of the normal changes during pregnancy and of the superadded trauma which normally occurs in labour. The puerperium may be said to extend over 6 to 8 weeks though no exact time limit can be set. The size of the uterus is the most reliable sign of the completion of the puerperium.

The management of the puerperium consists in keeping careful watch upon the physiological processes during this time and in being prepared to intervene early and effectively, if they should show signs of becoming pathological. The following points must be watched: (1) pulse-rate and temperature, (2) involution of the uterus, (3) the lochia, (4) micturition and defæcation, (5) lactation, (6) sleep.

The most important considerations are:—

- (1) Attention to the proper feeding, comfort, rest, mental and physical welfare of the mother.
- (2) Attention to the proper action of all the excretory organs.
- (3) Prevention of septic infection and its more serious consequences.
- (4) Conscientious attention to and recording of the temperature, pulse-rate and progress of involution.
- (5) Care of the breasts, including their antiseptic care, the promotion of lactation and the nursing and care of the child.
- (6) Exercises designed to restore the tone of the abdominal wall and pelvic floor.

Prevention of Septic Infection.—Every precaution should be taken to prevent the implantation of exogenous pathogenic organisms into the birth-canal during labour and in the puerperium. Manipulations involving the exposure of the vulva and perineum should only be undertaken by those who are themselves free from infection, are wearing masks and have sterilized their hands by scrubbing. During delivery the vulva and surrounding skin are swabbed with an antiseptic solution or cream containing 2½ per cent. hibitane, or dettol, or cetavlon. In the

puerperium the vulva and perineum should be kept clean and dry. The patient is washed with soap and water twice daily from umbilicus to knees and a special clean wash-rag and towel should be kept for each patient for this purpose. Provided there is no rise in temperature she may sit in a bath on the fourth day after delivery. There is no need for swabbing the vulva or for pouring antiseptic solution over it after delivery or in the puerperium.

Between whiles the vulva must be kept covered with a dry sterile pad, which must be renewed by the nurse with surgically clean hands whenever it is soaked or soiled. The pads are secured with a T-bandage, which must also be frequently renewed. Dry sterilized dressings are now supplied in air-tight cartons at a nominal cost by nearly all the Local Health Authorities. During the changing of vulval pads, the nurse should wear an efficient spray-proof mask.

Relatives, nurses, students and doctors who have septic foci themselves, or may carry an infection from recent contact with septic conditions, or attendance at post-mortem examinations, must be prepared to exclude themselves or to be excluded from all labour and lying-in wards. Efficient masks must also be worn by doctors when making vulval or vaginal inspection for the first ten days after delivery. Suspect cases, *i.e.* those in whom the puerperium for various reasons involves an extra risk of sepsis, however slight that risk may be, should be nursed in separate wards, and patients unexpectedly developing signs indicative of sepsis should be at once isolated from the normal cases.

In order to reduce the risk of infection spreading, modern maternity units are designed so as to contain small wards of 4 to 6 beds. Ventilation should be by a positive pressure system so that pure fresh air is introduced into the ward rather than by extractor fans which suck infected air in from other parts of the hospital. Many organisms, in particular the staphylococcus aureus and hæmolytic streptococcus, are found in dust and in blankets. Only wet-dusting should be permitted in a maternity ward and exposure of the vulva allowed only when the dust has had time to settle. Single rooms should be provided for suspect cases and an isolation block made available in a building separate from the main maternity ward for infected patients.

The Promotion of Proper Drainage from the Genital Tract.—

The patient should be propped up in bed sometime in the first 24 hours, either with pillows, a bed-rest or on an adjustable bed. She should spend most of her time awake in this position, but she should be permitted to sleep almost flat or upon her side. In some clinics the women are encouraged to lie upon their faces for a short time each day, to help drainage by altering the position of the uterus, and to assist its

return to the anteverted position. From the beginning, free movement in bed and active movements of the limbs and trunk with deep-breathing exercises are encouraged.

Time of Getting Up.—There is no doubt that after the physical and mental strain of pregnancy and labour, a patient needs a period of rest from hard work and mental worry of at least 14 days.

Providing the labour has been normal, and there has been no gross injury to the pelvic floor or other complications, there is no need for the patient to spend the whole of this time in bed. In primitive races the mother leads a normal life immediately after delivery. Until recently the custom in this country was to keep the patient in bed for 10 to 14 days to allow most of the involution of the uterus to be completed before any weight was thrown on the stretched pelvic diaphragm. The present tendency is to allow the patient out of bed on the 4th day, but to keep her in hospital and limit her exertions till the 10th day. In many clinics the patient is allowed out of bed for short periods from the day after delivery. Early ambulation must not be made an excuse for shortening the total time of convalescence.

This period of relief from hard work and domestic worries will allow time for breast feeding to be comfortably established, and the slight amount of exercise which the patient is allowed to take will prevent her from becoming debilitated by prolonged rest in bed. The evidence suggests that the involution of the uterus and the recovery of the tone of the pelvic diaphragm are both improved by this system; the circulation is improved in the lower limbs and puerperal thrombosis reduced. In abnormal cases and when there has been severe laceration of the perineum, it may be necessary to keep the patient in bed for a longer time.

Temperature and Pulse.—The temperature may rise to 100° F. for a brief time in the first 24 hours, afterwards falling to normal and remaining so. Such rise of temperature is called reactionary, and is comparable with that which may occur in other conditions involving prolonged nervous and muscular strain.

Any febrile condition occurring in a woman in whom a temperature of 100·4° F. (38° C.) has occurred within 14 days of childbirth or miscarriage is defined as puerperal pyrexia by the Ministry of Health, and is compulsorily notifiable to the Medical Officer of Health by the practitioner attending the case or any other doctor who is aware of it.

It cannot be too strongly emphasized that when the temperature remains raised for more than a few hours, especially if there is a corresponding rise in the pulse-rate, it should be regarded as due

to infection arising in the genital tract, until the contrary is proved. The same is undoubtedly true of a very slight rise, perhaps of not more than 99.5° F., continued for several days, or of a definitely raised pulse-rate without an accompanying rise of temperature. In the Rules of the Central Midwives Board, the midwife is bound to call in a qualified practitioner not only when there is puerperal pyrexia but also 'if the temperature reaches above 99.4° F. on three successive days.'

For the first few hours after a normal confinement the pulse-rate is likely to be raised but should return to normal during the second day. The pulse-rate should be recorded at the same times as the temperature is taken. A rise in the pulse-rate must be regarded as seriously as is a rise in the temperature. It accurately indicates the general condition of the patient. A pulse-rate that is raised to a rate of about 96 per minute might accompany a severe anæmia, a local infection of the placental site, urinary tract or breast tissue, whereas if the rate is persistently above 110 a blood-stream infection should be suspected.

The Onset of Lactation.—During pregnancy there is considerable hypertrophy of the glandular tissue of the breasts, but secretion of milk does not start till after the birth of the child. After this time the breasts begin to become more active, and there is increasing vascularity and engorgement with milk. By the third or fourth day the breasts become tense, painful, and tender. The pain may produce some constitutional disturbance, such as headache and malaise, and slight rise of pulse-rate but will not as a rule produce any rise of temperature. Up to the third day, only a little colostrum is secreted by the breasts, but after a period of engorgement, the flow of milk begins. Excessive engorgement of the breasts with milk is dealt with on p. 615.

These symptoms are more marked in primiparæ than in multiparæ in whom the flow of milk often starts a little earlier.

All cases of fever during the puerperium should be carefully investigated as described in Chapter XLIII.

Involution of the Uterus.—The approximate rate of normal involution is indicated in Fig. 78. Each day following the birth of the child the height of the fundus above the upper border of the symphysis pubis is carefully measured and charted. This measurement must not be made unless the bladder, and if possible, the bowel are empty. A full bladder or a loaded bowel will raise the level of the fundus of the uterus and produce a fictitious reading. The uterus rapidly diminishes in size for the first week, then more slowly, being

completely involuted in approximately 8 weeks. At the end of labour the uterus weighs 2 pounds, by the end of the 1st week it loses 1 pound and during the 2nd week $\frac{1}{2}$ pound, for the remainder of the puerperium the loss in weight is much slower. By the end of the puerperium it has almost returned to its normal weight of 2 ounces. Involution is accomplished by autolysis of the muscle fibres, their protoplasm being broken down by ferments, liquefied and removed in the blood-stream.

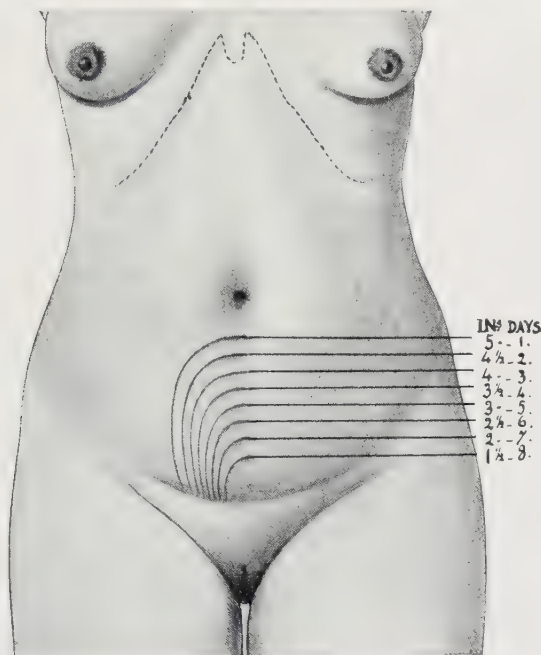


FIG. 78.—SHOWING NORMAL LEVEL OF THE FUNDUS OF THE UTERUS ON ABDOMINAL EXAMINATION DURING THE FIRST EIGHT DAYS OF THE PUERPERIUM

The end products are excreted in the urine. Failure of, or delay in, involution is indicative of a local uterine infection, or of retained placental fragments or blood-clot. Involution is also slower when fibroids are present in the uterine wall and in acute retroflexion of the uterus.

Retention of Urine.—Most patients are able to pass urine normally after labour. It is no longer considered necessary to swab the vulva after each act of micturition. It is not uncommon for a patient to have a certain amount of difficulty in passing urine for the first day or two after delivery and in a few retention of urine develops. This

condition is liable to occur, particularly in nervous primiparæ. after a difficult labour or when perineal stitches have been inserted. Among the causes of retention are laxity of the abdominal muscles ; atony of the bladder ; bruising, swelling and tenderness of the urethra or its immediate neighbourhood ; reflex spasm or actual pain from perineal lacerations or movement of the pelvis causing traction on the stitches and preventing further expulsive efforts ; and the position of the patient on her back.

The laxity of the abdominal muscles and the atonic bladder wall may permit of the distension of the bladder reaching a degree beyond that which usually excites the reflex arc, so that the desire to empty the bladder is not aroused. When the bladder is over-filled in this way only a small quantity may be passed at a time, not enough to empty the bladder, so that residual urine accumulates and may become infected. Retention with overflow may occur either from complete retention which has not been relieved, or following incomplete emptying with gradual over-distension of the bladder ; it is likely to be followed by cystitis.

Routine examination of the abdomen is essential in order to detect retention. If the distension of the bladder is of moderate degree the uterus is pushed upwards, if of greater degree the uterus is obscured and cannot be felt at all. Diagnoses of ovarian cyst, ascites and of uterine tumours are sometimes made by an attendant who has omitted to make an abdominal examination for several days. Passage of a catheter in any case will clear up the difficulty. Retention with overflow is the commonest cause of dribbling of urine, a symptom which should always be investigated by catheterization.

Care must be taken to ensure that retention, partial or complete, does not occur. The amount of urine passed on each occasion must be recorded, and the number of occasions when it is passed in the 24 hours. The patient must be given the bed-pan and micturition encouraged at 4-hourly intervals. If difficulty is experienced, an attempt must first be made to overcome this by alteration of position, because many patients who are unable to pass urine when sitting on a bed-pan in bed are able to do so without difficulty when sitting up out of bed on a commode. If this measure fails a catheter should be passed.

If retention occurs or residual urine in some quantity be suspected, the bladder must on no account be allowed to become over-distended because of the frequency with which cystitis follows and a catheter must be passed with due aseptic precautions and gentleness. Should the bladder have become atonic from over-distension, catheterization may have to be continued at regular intervals for days, or a self-retaining catheter inserted.

Incontinence of Urine.—False incontinence or incontinence with overflow is the result of retention with damage to the sphincter mechanism and temporary loss of control.

True incontinence results from a vesico-vaginal fistula due either to a tear involving the bladder from instrumental delivery, or due to pressure on the soft parts from long labour and later the formation of a slough extending into the bladder. In the latter case it does not generally appear until some days after labour.

Stress incontinence or inability to hold the water on straining is not uncommon after delivery. It is due to stretching and dislocation of the vesico-urethral junction from its attachments. If it occurs soon after labour, it is usually temporary. Occasionally when it is permanent an operation for the restoration of the supporting mechanism of the vesico-urethral junction will be necessary for its cure. The operation is not advised until many months, and possibly one or two years, have elapsed, because most cases that occur in the puerperium improve in time with the help of active perineal exercises and the regain of tone in the perineal musculature.

Cystitis and Pyelitis accompanied by severe constitutional symptoms and fever may arise in the first week of the puerperium. They may occur spontaneously from an exacerbation of a chronic coliform infection of the urinary tract after labour or may follow catheterization, or may accompany and be part of a general infection of the genital passages. They are generally due to infection with coliform organisms, streptococci or staphylococci.

Cystitis may be prevented by encouraging the patient to drink adequate amounts of fluid and to empty her bladder at frequent intervals. Retention and residual urine must be overcome by catheterization. Should infection occur it may be treated by an adequate fluid intake, an alkaline mixture containing potassium citrate 4.0 g. (gr. 60) four-hourly and a course of sulphonamide therapy, e.g. sulphamezathine 1.0 g. to begin and then 0.5 g. four-hourly until 25 g. have been given.

For details of treatment of pyelitis see p. 260.

Bowels.—The bowels are always somewhat atonic from release of the abdominal pressure and the lax abdominal walls, coupled with the great demands of the breasts for their share of the fluid intake. Purgatives are nearly always needed. Salines should be avoided as they decrease the fluid content of the milk. Almost any other aperient can be used, but those which act on the muscular walls of the bowel are the best. A purgative that will act briskly should be given on the second night; and if that is not effective an enema may also be required. The

best purgatives for the first action are cascara, liquorice powder or vegetable laxative pills. After this paraffin, senna, or phenol-phthalein will usually suffice, ample fluids are given to supply the demands of the milk secretion as well as the bowel movements. Aperients which act effectively on the mother often affect the child adversely as they are all in some degree transmitted to the child in the milk.

The Lochia.—The lochia arise from the large wound left in the uterus following the separation of the placenta. For the first 3 or 4 days of the puerperium the lochia are red in colour. As the wound commences to heal the amount of the discharge begins to decrease, as also does the proportion of red blood therein. The lochia change from red to pink as the amount of blood diminishes, and later become serous.

Although it has always been stated that the lochia disappear by the 10th day after the confinement, a recent investigation showed that the average time before they became colourless was 24 days. Certainly some increase of red lochia is often seen in patients who get up for the first time on the 10th day.

It is most important that at each visit the medical attendant should inspect the vulval pads to see the condition of the lochia. Offensive lochia may indicate infection of the genital tract although infection by hæmolytic streptococci is not accompanied by offensive smell.

Lochia which remain red in colour and excessive in amount usually indicate delayed involution which may be associated with the presence of a small portion of placenta or membrane within the uterus, or of fibroids in the uterine wall.

Sleep and the Avoidance of Anxiety.—It is important to see that the patient not only gets her proper night's rest free from the possibility of disturbance by the baby, but also that she has a rest in the afternoon. Pain from perineal stitches, hæmorrhoids and distended breasts are common causes of sleeplessness. If she is excitable and sleeping badly, hypnotics, such as quinalbarbitone 0.2g. (gr. 3), should be given on the first few nights. After that sleeplessness, unless it is habitual, should arouse anxiety as it may be an early sign of the onset of mental disturbance.

It is wise to forbid visitors, with the exception of her husband and mother, for the first week. The patient is in need of rest, both mental and physical, and should be protected against worry and undue fatigue at this time.

Food.—The day after a normal delivery the patient should be given a normal full diet. During lactation she needs a considerable

increase of her intake of proteins and fats to compensate for those secreted in the milk. So that once the flow of milk is established, the fluid intake and the protein in the diet should be increased.

The diet should contain at least a pint of milk daily to supply the necessary vitamins and when lactation is well established, fruit and vegetables should be increased. Vegetables, salads and animal fats are the best sources of vitamins which will be required for the child's nutrition. If they are not well tolerated, one of the well-known vitamin-rich foods, such as marmite or radiostoleum, can be taken by the mother.

Stitches.—Night and morning the perineum should be washed with soap and water and dried. A clean dry sterilized dressing is then applied to the perineum and changed frequently. Unabsorbed stitches may be removed on the 5th or 6th day.

Visits to the Patient.—The number of visits paid to any patient will depend on her special requirements, but it is best to visit an uncomplicated case daily for the first four days, and then at longer intervals, so that visits cease after the end of the 3rd week. At each visit the nurse's report should be received, if possible before the patient is seen. A chart, on which are recorded the pulse-rate, temperature and involution curve, should be kept. The abdomen should be palpated to discover if the uterus is diminishing in size as rapidly as it should. The amount and character of the lochia must be investigated. The breasts and nipples should be inspected and inquiry made as to any difficulty in suckling. If the patient is not sleeping well an attempt should be made to find the cause. If a cause cannot be found, mental disturbance should be considered. The behaviour of the bowels and bladder must receive attention.

The chief points to be investigated about the child are whether it takes nourishment well, whether it sleeps well, the condition of the eyes and the umbilical cord and umbilicus, the character of the motions, any difficulty in passing water, and the weekly increase in weight.

Care of the Breasts.—At the first antenatal consultation, the patient should be advised on the preparation of the nipples to enable lactation to be carried out without difficulty or complications. The breasts and nipples should be inspected; if normal she should be told to wash the breasts and nipples daily during the last three or four months of pregnancy with soap and water, to dry the nipples firmly with a rough towel and then rub a little grease (lanoline or olive oil) into the skin of the whole breast and nipple. Should the nipples be flattened or retracted, in addition to the above instructions, she should

be shown how to draw out the nipples, which she should do daily to aid suckling. The wearing of nipple shields under the brassière gently assists in causing retracted nipples to become protractile.

During the latter half of pregnancy, secretion oozes from the milk-ducts in small quantity and dries on the nipple, where it forms small adherent scales. These will be removed by the daily washing mentioned above. On the other hand, if no preparation is undertaken for lactation the scales may become firmly united to the superficial epithelium and thus leave a partially raw surface when detached. If these crusts are very adherent, they should be softened by applying to the nipples a compress of sterile olive oil for 24 hours, and then washing them off with soap and water. Patients who learn to express their breasts before delivery are better able to prevent milk engorgement by manual expression in the puerperium.

During the first 2 or 3 days the breasts secrete colostrum only, but it is important that the child should be put to the breast in order to stimulate the secretion of milk and to teach it to suck. Another advantage in putting the baby to the breast soon after delivery is that its mouth becomes colonised with relatively harmless bacteria from its mother, but if there is delay its mouth may become colonised with staphylococci which can infect the mother's breast. The colostrum also has some laxative effect on the child. Since the amount of colostrum is small, the child should only be put to the breast every 6 hours, and not allowed to remain there more than 5 minutes, as otherwise the child may continue sucking after the breast is emptied, and thus make the nipple sore. The baby may be put to the breast on the 2nd day six-hourly, and on the 3rd four-hourly, and the period of suckling increased a few minutes each day. Before each feed the nipples which have been kept covered with a sterilized dressing, should be bathed with sterile water or boracic lotion. In the majority of cases the patient will be more comfortable if the breasts are supported but not bound.

The mother should never be allowed to go to sleep while the child is sucking for fear of overlying the child, and the child should never sleep while at the breast, because the nipple is likely to become soft and sore by being retained too long in the mouth.

Postnatal Exercises.—Now that patients are allowed to get out of bed earlier, postnatal exercises are not so important as they were when patients were kept in bed for 2 weeks. In most hospitals on the day after delivery patients are given breathing exercises, exercises to stimulate the abdominal and pelvic muscles, and exercises to the legs to encourage the circulation and so reduce the risk of thrombosis.

Postnatal Examination.—This should be carried out at the end of the 6th week. At such examinations enquiry should be made as to how she sleeps, whether her appetite is normal, whether the lochia have ceased, whether the action of the bowels and bladder are normal, whether she suffers from any unusual aches or pains, and lastly, whether breast feeding presents any troubles or difficulties. The patient's general health and outlook on life are noted during this enquiry. The mucous membranes are examined for signs of anæmia. A note is made of the state of the abdominal musculature and whether involution is so imperfect that the fundus of the uterus can still be felt. Pelvic examination includes the observation that satisfactory healing has occurred in any sutured laceration, and that, on straining, there is no undue prolapse of the vaginal walls and uterus. Vaginal examination should be performed and the size and position of the uterus noted. The uterus may be retroverted. If the patient complains of sacral backache, it should be replaced and the patient examined again in a month to discover its position. Should it have stayed forward, no treatment would be required. On the other hand, if it again becomes retroverted, it should be anteverted and maintained in the forward position for 3 months by means of a pessary. The vagina and cervix should be inspected. Erosions of the cervix should be cauterized if they are giving rise to discharge.

The site of any backache should be ascertained. If this pain is referred to the sacral area it may be associated with prolapse or retroversion, but if to the lumbar region, it is more likely to be associated with a faulty posture and exaggerated lordosis. The pain may also occur over one or both sacro-iliac joints. Appropriate additional investigations and treatment should be started at once for any disability discovered at these postnatal examinations.

CHAPTER XVI

HYPERTENSION AND ALBUMINURIA DURING PREGNANCY

PRE-ECLAMPTIC TOXÆMIA

Toxæmia of Pregnancy

THE term toxæmia of pregnancy was applied to a number of diseases which are of unknown ætiology and peculiar to pregnancy. The term was founded on the belief that these diseases were due to the presence of a toxin in the mother's blood. The name toxæmia became so well established that it continued to serve its purpose of referring to a whole collection of different diseases although no toxin was isolated in any of them. These diseases may own a common ætiology or it may be that each has an entirely separate ætiology such as deficiency disease, hormonal imbalance or, indeed, toxæmia in the literal sense. The several diseases which fall into this category can be classified as follows:—

- (a) Pre-eclampsia, including the severe form, impending eclampsia.
- (b) Eclampsia, in which fits take place.
- (c) Chronic nephritis, which may undergo exacerbation during pregnancy.
- (d) Essential hypertension, upon which pre-eclampsia may become superimposed.
- (e) Bilateral symmetrical cortical necrosis of the kidneys, a rare complicating factor of pre-eclampsia, eclampsia or chronic nephritis.

The term *pre-eclampsia* is used here for the variety of toxæmia in which œdema, hypertension and albuminuria develop in late pregnancy. This particular name is adopted because British clinicians are making an attempt to standardize the nomenclature for this group of diseases, following the example set by obstetricians in the United States of America. The name stresses one particular feature of the disease, *i.e.* that *eclampsia* is liable to follow it. Other names in common usage for the same condition, albuminuria of pregnancy, late pregnancy toxæmia, hypertensive toxæmia and pre-eclamptic toxæmia, are therefore discarded in favour of pre-eclampsia for the sake of uniformity. *Impending eclampsia* refers to a recognized syndrome of

severe pre-eclampsia in which the onset of eclampsia becomes imminent. In established eclampsia fits are present. The symptoms and signs of impending eclampsia follow on severe pre-eclampsia and herald the onset of convulsions. Sometimes eclampsia occurs apparently without warning. In that case it is assumed that the preceding stages of pre-eclampsia and impending eclampsia existed before the onset of fits for such a short space of time that they passed unnoticed. The condition is then called *fulminating eclampsia* and accounts for most of the cases which occur in spite of very careful antenatal supervision.

It is generally recognized that pre-eclampsia, impending eclampsia and eclampsia itself are three stages of the same toxæmic disease and should be regarded as a single entity. Furthermore, it must be clearly understood that all gradations of the disease occur, from a trace of albumin in the urine of an apparently healthy pregnant woman to repeated epileptiform convulsions, followed by deepening coma, a rapid thready pulse and a dilating heart, in a dangerously ill patient.

The chronic diseases of nephritis and essential hypertension are included in the same group, although they are not, strictly speaking, toxæmias. The exacerbations of these diseases in pregnancy resemble pre-eclampsia, and complicating factors, such as accidental hæmorrhage and death of the foetus *in utero*, are similar to those found in the toxæmias. The exacerbations of chronic nephritis and hypertension in pregnancy may be regarded as instances of superimposed pre-eclampsia.

Albuminuria During Pregnancy

Albuminuria is a symptom and not a disease *per se*. Albumin is found in the urine in about 5 per cent. of all pregnant women. A note on the testing of urine is included because it is so important and so frequently wrongly done. Albumin can be detected in the urine by boiling or adding salicyl-sulphonic acid. The urine to be tested must be clear. If it is not quite clear it should be filtered. Two or 3 inches of urine are placed in a test tube. The upper portion of urine is brought to the boil over a flame. The lower portion which does not boil acts as a control. If clouding occurs in the boiled upper portion it may be due to albumin or earthy phosphates. A few drops of 5 per cent. acetic acid are added. The clouding due to phosphates will disappear but that due to albumin will remain. Even if no clouding occurs on boiling it is still necessary to add the acetic acid after boiling. The other, more sensitive, test can be carried out by the adding of a few drops of a 25 per cent. or saturated solution of salicyl-sulphonic acid to clear urine. Clouding occurs with albumin or proteose. The clouding of proteose disappears on heating, then reappears on cooling.

Albumin can be detected in the urine quickly and easily by dipping a reagent strip such as "Albustix" (Ames Co. Ltd.) into it and looking for a change in g. colour of the strip from yellow to green. Albumin may



FIG. 79.

ESBACH'S ALBUMINOMETER.

be measured quantitatively in Esbach's albuminometer (Fig. 79). Clear acid urine should be used. The specific gravity of the urine must be brought down to 1008 by adding water if it is above that figure. If it appears that the level of the precipitate is going to be above the mark 4 on the tube then the urine should be diluted and another estimation made. In each case when urine is diluted a correction of the reading for dilution will be necessary. An Esbach's tube is filled with the urine to be tested to the mark U, and Esbach's reagent (picric acid 10 g., citric acid 20 g. and distilled water 1 litre) is added to the mark R. The tube is closed with a rubber stopper, the urine and reagent are gently mixed and the tube is left to stand vertically for 24 hours. At the end of that time the level of the precipitate is read against the number marked on the tube. This figure represents the number of grams of dried albumin per litre of urine, or parts per thousand. To get the percentage, the figure is divided by 10.

A more accurate method of determining the amount of albumin in urine is to compare photo-electrically the turbidity produced on adding salicyl-sulphonic acid with a known standard. "Albustix" can also be used by comparing the depth of colour change produced with the colours on a special chart.

If albumin is detected in the urine of a pregnant woman its cause should always be investigated. It may be due to:—

- (a) Pre-eclampsia and eclampsia.
- (b) Chronic nephritis.
- (c) Essential hypertension with superimposed pre-eclampsia.
- (d) Urinary tract infection.
- (e) Vaginal contamination.

(f) Orthostatic albuminuria, a rare condition.

(g) Other rare and self-evident causes: acute nephritis, advanced diabetes, severe hyperemesis gravidarum, heart failure, severe anæmia, pyrexia, systemic lupus erythematosus with renal involvement.

Vaginal contamination should be excluded by examination of a catheter specimen of urine. Pus cells in the non-centrifuged urine in a concentration of more than six cells per microscopic field with the use of the 1/6th inch objective indicate a urinary tract infection. In orthostatic albuminuria albumin disappears from the urine overnight and is absent in the early morning specimen. It appears when the patient assumes the upright posture during the day. It is a rare cause of albuminuria. It may be an easy task to differentiate between pre-eclampsia on the one hand and chronic nephritis or essential hypertension associated with toxæmia on the other hand, if records of previous observations made on the patient are available. This is often not the case, and it may be impossible to make a definite diagnosis during pregnancy. Usually a good guess can be made and its accuracy checked after delivery.

The Biochemistry, Ætiology and Pathology of Pre-Eclampsia and Eclampsia

Biochemistry.—Hitherto biochemical investigations have failed to elucidate the primary factors which determine the toxæmic conditions which are under consideration. They have reflected the results of derangement but they have not thrown any real light on ætiological antecedents. Moreover, a true parallel has not been established between the extent of any recognized biochemical deviation and the severity of clinical symptoms associated therewith. Thus, there may be found but little evidence of nitrogen retention or acidosis even in cases of eclampsia which terminate in death.

Ætiology.—Any theory which sets out to explain the cause of pre-eclampsia must account for certain known facts about the disease. It occurs more commonly in primigravidæ, in cases of multiple pregnancy, in the presence of hydramnios and hydrops foetalis and in diabetics. That a foetus need not be present is shown by the high incidence (30 per cent.) of pre-eclampsia in cases of hydatidiform mole. In fact, the patient may not even be pregnant because eclampsia may not develop until some hours after delivery, a condition known as post-partum eclampsia. Here it is presumed that eclampsia occurs as the result of changes initiated during pregnancy but not becoming effective until the period immediately following delivery. It is very rare indeed for eclampsia to occur more than 24 hours after delivery. So far there

is no satisfactory explanation of pre-eclampsia. Many theories have been advanced. Most of them attempt to explain the mechanism rather than the underlying cause of toxæmia. It is well to admit at the outset that, although a great deal of information about pre-eclampsia has been collected, and many theories advanced we are still no nearer to a comprehensive explanation of its cause.

Among the theories which have been put forward are the following:—

The toxæmia theory.—In this theory it is assumed that circulating toxins are responsible for the symptoms and signs of toxæmia. The draw-back to such a theory is the fundamental objection that all attempts to isolate any toxin from the blood have failed, and it is no longer held that the lesions found in the liver and kidneys in patients who have died of eclampsia are definite evidence of such toxins. They could, for instance, be vascular in origin. Certain physiological elements contained in the blood in normal pregnancy, *e.g.* hormones and enzymes, have been found in excess in some cases of toxæmia, but they are not present constantly in larger amounts than normal, and not often in such great quantities as to suggest actual poisoning of the body. The theoretical site of origin of toxins could be maternal, foetal, placental or uterine. At one time it was thought that pregnancy threw an increased strain on the work of the maternal liver and kidneys so that metabolic waste products failed to be removed and accumulated in the blood. But the blood-urea in pregnancy is normally low as compared with that of a woman who is not pregnant, and the blood-chemistry is normal. Variations in the acid-base balance have been investigated but no significant changes have been found. Clearly a foetal toxin cannot be the cause of toxæmia in the case of hydatidiform mole. Modern theory inclines to the view that the placenta or uterine wall is the site of origin of toxins. It has been postulated that interference with the maternal blood-supply to a part of the placenta leads to necrosis of the covering chorionic epithelium and engorgement of the foetal villous blood-vessels. This degenerated part of placenta is recognizable as a red infarct and from it tissue toxins may be derived. But placental infarcts are not an invariable finding in toxæmia. Moreover, their presence does not always mean the co-existence of toxæmia. Lately attention has been focused upon the uterus itself as a possible site for the formation of toxins. It has been suggested that a reduced blood-supply to the distended uterus, in primigravidæ, twins or hydramnios, might lead to the accumulation of ischæmic waste products. It was thought that these products might be pressor substances, similar to renin which is released from a kidney which has had the artery clamped by Goldblatt's method. In America one worker

claimed the discovery of a toxin called menotoxin, which was supposed to come from the uterine decidua as the result of a complicated series of endocrine changes. No one else has been able as yet to find this toxin. The finding of low levels of the enzyme histaminase in the blood and placenta of the toxæmic patient compared with the levels in the normal pregnant woman has led to the supposition that excess of histamine is being produced, but, again, this is not proved.

The endocrine theory.—Most of the endocrine glands have been involved in theories to account for toxæmia. It was suggested that hyperactivity of the posterior lobe of the pituitary gland was responsible. Excess of pressor hormone could raise the blood-pressure and anti-diuretic hormone might cause œdema. Adrenal hormones in excess have also been suggested. Adrenalin has a pressor effect and the mineralo-corticoids cause retention in the body of sodium and water and hence œdema. It is known that certain adrenal cortical hormones are produced in greater amounts in pregnancy. In fact it was the observation that rheumatoid arthritis improved during pregnancy which first led to the isolation of cortisone. Those anxious to blame the adrenal glands now think that toxæmia of pregnancy may be due, not to an actual excess of adrenal cortical hormone, but to an imbalance between the production of the gluco-corticoid hormones and that of the mineralo-corticoid hormones. The placenta may be concerned in this imbalance. It is known that the progesterone blood-level is low in toxæmia and that the adrenal glands can convert progesterone into adrenal cortical hormones. Moreover, there is some evidence that the placenta may itself secrete adrenal-like hormones.

Recently F. J. Browne has elaborated an ingenious theory implicating the adrenal glands and explaining post-partum eclampsia. He pointed out the similarity between Cushing's disease, in which there is an excess of adrenal cortical secretion and pre-eclampsia. He suggested that it is normal in pregnancy for there to be an excess of adrenal cortical secretion, but the effect of the cortico-steroids is normally inactivated by an oxygen-dependant enzyme secreted by the placenta. When there is placental ischæmia, or sometimes with removal of the placenta post partum, the inactivating enzyme is no longer secreted and toxæmia occurs. There are many assumptions in this theory which require confirmation.

In the elaboration of the toxin theory, mentioned above, it was established that certain endocrine changes were the rule in toxæmia of pregnancy. The gonadotrophin level in the blood and serum is higher while the levels of œstrogen and progesterone are lower than in normal pregnancy. The significance of these changes, however, is not clear. Diabetic patients are known to be predisposed to

pre-eclampsia. For this reason a number of pregnant diabetics were treated with oestrogens in Boston, U.S.A. Although the incidence of pre-eclampsia was not appreciably decreased the foetal mortality-rate was greatly improved, an observation which has not, hitherto, been satisfactorily explained. Other workers are not so impressed with the use of oestrogens with or without progesterone in diabetes and pregnancy.

The nutritional theory.—Over-nutrition was considered to be a cause of toxæmia on the assumption that it led to the absorption of toxic intestinal protein derivatives which an overstrained liver was unable completely to metabolize. Part of the evidence for this hypothesis was the low incidence of eclampsia during the blockade of Germany in the 1914-1918 war, when a very low level of nutrition was reached. In Dublin the treatment of eclampsia by a low protein diet and high colonic wash-outs was carried out to rid the intestine of protein poisons. But such efforts were ineffective and merely stimulated more fits. It is possible that the relatively infrequent occurrence of eclampsia during times of semi-starvation is due to the lesser number of first pregnancies. But in support of the theory it is interesting to note that when food was dropped into Holland in 1944 during a period of starvation a severe outbreak of eclampsia occurred. Undernutrition is also blamed for toxæmia. Deficiencies in the diet of calcium, vitamin B₁, and vitamin D have been separately blamed for toxæmia. While pre-eclampsia has not been prevented by supplements to the diet, it has been shown in large scale experiments, as in the People's League of Health Experiment in 1938, that supplements of vitamins and minerals reduce the overall incidence of pre-eclampsia.

Other theories.—Theories such as the water-poisoning theory seek to explain the mechanism rather than the cause of toxæmia. In this hypothesis oedema of the tissues is the underlying cause of the signs. Hence, oedema of the brain causes eclamptic convulsions, oedema of the vaso-motor centre causes hypertension, and oedema of the kidneys causes albuminuria. An increased capillary permeability was postulated to account for the oedema. A reduction in the concentration of plasma proteins or an excess of circulating oestrogen have been suggested as alternative reasons for the oedema. But the plasma proteins are normal and the oestrogens reduced. A retention in the tissues of sodium chloride has been shown to exist in a few cases, and intravenous injection of saline may precipitate eclampsia in some women suffering from pre-eclampsia. But these findings are by no means invariable. It seems that in a few women the mechanism of production of the signs of pre-eclampsia may be associated with abnormal balances of water, sodium, potassium and chloride.

There is a widespread belief, gaining in popularity, that the underlying disturbance of toxæmia of pregnancy has a vascular basis. This is supported by consideration of the pathological lesions in eclampsia. The vascular changes may in turn be caused by placental toxins.

In conclusion, with our present knowledge, the origin and mode of development of the symptoms and signs of pre-eclampsia and eclampsia are hypothetical. The above discussion has been included to try to give the reader an idea of some of the many avenues which have been explored in a prolonged research.

Pathology.—In a recent survey in England and Wales it was shown that deaths from pre-eclampsia and eclampsia accounted for nearly one quarter of all the deaths due to pregnancy and childbirth. About 40 per cent. of the deaths were due to eclampsia, 40 per cent. to pre-eclampsia and 20 per cent. to accidental hæmorrhage. The most striking changes are seen in cases of eclampsia but the difference between this condition and pre-eclampsia is probably only one of degree of severity, and there is every reason to believe that their pathology is identical.

Fatal cases of eclampsia show lesions in the liver, kidneys, heart and brain; these changes are most characteristic in the liver.

The liver.—This organ is usually enlarged. There are irregular areas of hæmorrhage beneath the capsule, which produce a mottled appearance. On section, these hæmorrhagic areas are seen to be present throughout the liver substance, which itself may be partly or wholly necrotic and yellow in colour. The hæmorrhagic areas are in the first place small petechiæ, but should they be numerous they are confluent, with the result that large areas of necrosis are formed.

Microscopic examination reveals that the lesion is situated at the periphery of the lobules in the region of the portal vein. Two main types of lesion are produced, the focal and the diffuse. In the case of the focal lesion there are peri-portal hæmorrhages which have occurred at the portal ends of the columns of liver cells, pushing those cells in a sleeve of connective tissue towards the central vein. The hæmorrhages coagulate into a mass of fibrin and, pressing on adjacent liver cells, cause necrosis of two or three neighbouring cells at the portal end of the column. The diffuse lesion is a more advanced degree of the focal one, and is very extensive. Here the hæmorrhages strip whole columns of liver cells away from their supports. The blood does not coagulate, but forms fluid channels from the portal to the central vein separating columns of necrosed liver cells. These lesions are distributed in a patchy manner. Areas of complete necrosis show the diffuse lesion and areas of less complete necrosis the focal lesion.

It is the peripheral lobular necrosis which is so characteristic of eclampsia that its absence rules out that diagnosis. In fact, patients dying without convulsions but showing the lesion are described as having "eclampsia without fits".

Kidneys.—The kidneys are usually enlarged. On section the surface of the cortex is broad and pale, forming a marked contrast to the deeply congested medulla.

The glomerular lesions are now considered to be the essential renal lesions. The glomeruli are all equally affected. They are slightly enlarged and the tufts may bulge into the tubule. The capillary loops are considerably dilated in places and narrowed in others. The capillary endothelial cells are swollen and fine fibrils appear between them and the basement membrane. This appearance has been described as reduplication of the basement membrane, but the fibrils may be derived from the endothelial cells. The capillary epithelial cells are swollen and in some cases they may undergo proliferation and join with a collection of proliferated cells of the glomerular capsule to form a small crescent. The collecting tubules often contain numerous albuminous casts which lead to degeneration of the tubular epithelium. The convoluted tubules may show some hyaline degeneration, but no necrosis. The afferent arterioles to the glomerular tuft show in the stalk a similar subendothelial fibrillary change to that seen in the capillary loops.

Heart.—Acute dilatation of the heart is usually found post-mortem. The cardiac muscle is pale and cloudy swelling of the fibres is commonly present. Subendocardial changes on the left side of the interventricular septum, similar to those seen in shock, are occasionally found.

Brain.—Hæmorrhages can be seen with the naked eye in about a third of cases. They may be in the pons, in the basal ganglia or in the subcortical white matter. They vary in size from very small to massive. Minute capillary hæmorrhages are sometimes found in the cortical grey matter. Œdema of the brain is not marked.

Lungs.—The lungs may show evidence of terminal bronchopneumonia.

Suprarenals.—There may be hæmorrhages or areas of necrosis in the suprarenals.

Pre-Eclampsia

Symptoms and Signs

Pre-eclampsia occurs in about 3 per cent. of pregnant women. It is relatively more common in primigravidæ, with hydramnios, and in cases of multiple pregnancy. The disease usually begins after the 32nd week of pregnancy and, in the majority of cases, continues until

after the patient is delivered. The onset is generally insidious and the progress slow, but a few cases develop severe symptoms and signs very rapidly and pass into eclampsia before they can be properly treated. This type is known as fulminating eclampsia. Both race and geographical situation appear to determine to some extent the proportions of mild and severe cases which are encountered. Thus the disease varies in its natural history from place to place and from country to country. Certain complications tend to arise, the chief of which is the onset of convulsions, eclampsia, which occurs in about one case in 30 in London. Accidental hæmorrhage occurs in about one case in 10 and in about the same proportion death of the foetus takes place *in utero*. A certain number of cases, approximately 25 per cent., are left with a permanently raised blood-pressure.

The chief symptoms and signs are as follows:—

Œdema.—This is a common early symptom, and affects the feet, legs, later the hands, face, abdominal wall and sometimes the vulva. Œdema of the feet and legs occurs so frequently in the later weeks of pregnancy that its appearance does not, as a rule, send the patient to seek the advice of her doctor. A slight degree of œdema of the feet and hands occurs in normal pregnancy. Œdema of the feet becomes more marked in the presence of twins or hydramnios or when there are varicose veins.

Abnormal gain in weight.—An increase in weight above the normal may be indicative of occult œdema due to water retention and makes its appearance before demonstrable swelling and pitting. The normal gain in weight in pregnancy is between 14 pounds and 34 pounds, with an average of 24 pounds. This gain is at a rate of 1 pound per month for the first 3 months, and then a little less than a pound per week until just before the onset of labour, when there is a loss of 2 or 3 pounds. It is estimated that the foetus, liquor, placenta and the increase in the weight of the uterus and breasts amount to about 14 pounds. The extra weight gain is largely due to the retention of water in the tissues, associated with sodium and chloride, as well as an actual gain in flesh. A sudden and dramatic gain in weight should be regarded as a premonitory sign of pre-eclampsia.

Urinary changes.—Albuminuria is slight in the early stages, although as the condition advances the quantity may reach 5 parts or more per 1000. Microscopical examination of the urine shows the absence of any blood or pus cells, but an occasional granular cast may be found in the urine of a case of some weeks' duration.

The quantity of urine secreted in the day may be decreased, and if it amounts to less than 600 c.c. (20 ounces) in the 24 hours, the condition is to be regarded as serious.

The blood-pressure.—A rise in the blood-pressure may take place before albumin has been detected in the urine. In the absence of any response to treatment, this rise is slow and steady. An increase of the diastolic pressure is of more serious import than a rise in the systolic. A systolic pressure of more than 140 mm. Hg or a diastolic pressure of more than 90 mm. Hg are to be regarded as pathological. Equally as important as the actual level of the blood-pressure is a sudden increase, although the pressure may not rise to a level as high as 140 mm. Hg systolic or 90 mm. Hg diastolic. For instance, if in an individual case the blood-pressure throughout pregnancy has been 110 mm. Hg systolic and 70 mm. Hg diastolic a rise to 130 mm. Hg systolic and 85 mm. Hg diastolic is to be regarded as pathological.

Other symptoms.—Symptoms such as severe headache, flashes of light, dimness of vision or spots in front of the eyes, epigastric pain and vomiting or oliguria occur only in the most severe cases. They indicate that eclampsia may occur within a matter of hours (see *Impending Eclampsia*, page 181).

Late effects

After delivery it is usual for the symptoms and signs to disappear rapidly. Twenty-five per cent. of women who suffer from pre-eclampsia are found to have a permanently raised blood-pressure following the pregnancy: 50 per cent. of those who become pregnant again have another attack of pre-eclampsia. A patient who had pre-eclampsia in a first pregnancy but has no toxæmia in a second is unlikely to develop pre-eclampsia in subsequent pregnancies (see p. 179). There is no evidence to show that the risk of chronic hypertension or recurrence of toxæmia increases with the length of time during which pre-eclampsia is allowed to persist. For other reasons, however, it is usually undesirable to allow a toxæmia to last too long. There is always the danger of the toxæmia becoming worse and eclampsia or accidental hæmorrhage or intracranial hæmorrhage occurring. Of equal importance is the risk to the fœtus. The longer a toxæmia is allowed to last the greater is the chance of the fœtus dying *in utero* and becoming macerated. Prolonging pregnancy in a case of pre-eclampsia unfortunately seldom results in much increase in size of the fœtus.

Diagnosis

It is unlikely that, under careful supervision, pre-eclampsia will terminate in eclampsia. Owing to the insidious onset and to the apparent unimportance of the symptoms to the patient, the detection of pre-eclampsia rests almost entirely upon routine examinations of

the woman, her urine, and her blood-pressure at regular intervals throughout the pregnancy. Whether the incidence of this disease, can be prevented, or even lessened, by measures such as the correction of errors in diet remains as yet unproven, but there is certainly no doubt that the detection and treatment in the relatively early stages of the disease are of the utmost importance.

In the majority of cases there is no difficulty in diagnosis provided that antenatal care has been carefully and conscientiously performed. Œdema, hypertension and albuminuria appear in the last few weeks of pregnancy in a woman known to have been normal before. Even in the absence of albuminuria, when hypertension and œdema are present in a previously normal patient, it is better to regard her as suffering from pre-eclampsia and to observe her in hospital. She must be carefully watched for the onset of albuminuria, when the diagnosis of established pre-eclampsia is made. Cases with physical signs early in pregnancy may be impossible to diagnose for certain during the pregnancy; they may be suffering from toxæmia, or else they may be cases of chronic hypertension. Women who do not develop signs of pre-eclampsia until after the 32nd week of pregnancy are suffering from toxæmia. And those with physical signs before the 20th week of pregnancy are probably suffering from a chronic disease: thus they have essential hypertension if there is a raised blood-pressure only, or chronic nephritis if albuminuria is also present. An exception to this rule is seen in women with a hydatidiform mole or monovular twins with acute hydramnios, because in them pre-eclampsia may occur very early in pregnancy, about the 20th week.

To be able to make a diagnosis in women who present themselves for the first antenatal examination with the physical signs of pre-eclampsia already established between the 20th week and 32nd week it is necessary to consider both the past medical history and any observations made on the blood-pressure and urine before conception, and in the early weeks of pregnancy. Often this information is unobtainable and therefore only an intelligent guess can be made to distinguish between early toxæmia or chronic disease. It is usually possible by subsequent observation to decide after delivery. Generally there is no urgent need to differentiate between toxæmia and chronic disease because the treatment is the same in both cases.

Treatment

Patients must be immediately admitted to hospital in order that sufficiently frequent observations on the blood-pressure and urine can be made. By this means deterioration can be detected at once. The main objects of treatment are the prevention of (a) eclampsia, (b)

permanent hypertension, and (c) death of the foetus *in utero*. The best method of obviating the two former dangers would obviously be to terminate pregnancy by the induction of labour as soon as albuminuria is detected. In many cases this would lead to the birth of a very premature foetus. On the other hand, if the interests of the foetus alone are being considered, the longer the pregnancy is allowed to continue the better the chances of survival of the child apart from the risk of its death *in utero*, which increases with the duration of the toxæmia. The risk of causing permanent hypertension used to be one of the reasons for inducing labour in cases in which albuminuria had persisted for more than 14 days. Although it is no longer generally believed that the time during which a toxæmia is allowed to last determines whether hypertension persists or disappears, the rule to induce labour after 14 days is, in most cases, a good one. By that time the foetus may be large enough to survive when born and it is often better to free it from the hazard of death *in utero* and the mother from the risk of eclampsia than to let the pregnancy and toxæmia continue. Statistics show that three times as many foetuses are lost from death *in utero* as die from prematurity. In exceptional cases it may be better, however, to allow the pregnancy to continue for more than 2 weeks in the presence of toxæmia so that the foetus may grow. This is so when the toxæmia begins comparatively early in pregnancy, say at 30 weeks. Unfortunately in pre-eclampsia the foetus often remains very small and fails to grow because the placenta too is small and inefficient. The onset of symptoms and signs of impending eclampsia, in spite of expectant treatment, affords a special indication for the termination of pregnancy. In moderately severe cases under treatment, when the blood-pressure is above 160 mm. Hg systolic and 100 mm. Hg diastolic and when there are 2 parts or more of albumin per litre of urine, it is unwise to wait longer than 3 or 4 days in the absence of improvement before inducing. When induction of labour is indicated rupture of the membranes is the method usually adopted.

Until there is an indication to induce labour cases of pre-eclampsia are treated by rest and observation in hospital. Sedative drugs and diet are secondary considerations.

Rest in hospital is essential. As the patient rarely feels ill and has no particular inclination to rest, it is necessary to confine her to bed and keep her under strict supervision. Insomnia is frequently present and should be treated with a sedative such as chloral 1·2 g. (gr. 20), or quinalbarbitone 0·2g. (gr. 3). By this simple procedure the progress of the disease is usually halted. In some cases the clinical manifestations become worse in spite of adequate rest, and in these circumstances labour should be induced. In a very few the signs disappear alto-

gether. These patients are then allowed up and, if the signs do not reappear, they may go home under observation. Improvement usually follows rest but the physical signs remain in lesser degree. The most marked effect is upon the blood-pressure and œdema. The albuminuria becomes less in amount, as shown by Esbach's albuminometer, but seldom disappears.

Various diets have been advocated by holders of particular theories of the ætiology of pre-eclampsia. There is some evidence that an adequate intake of calcium and vitamins B and D is necessary. There has been doubt about the optimal proportion of protein in the diet. At one time it was believed that toxæmia was caused by tissue intoxication with ingested protein metabolites; that the specific dynamic action of protein tended to raise the blood-pressure. Low protein diets were therefore advised. But then it was pointed out that a low plasma protein level (never actually confirmed) could account for the œdema by the reduction of intravascular osmotic pressure. A leakage of albumin through the kidneys further decreased the theoretically low plasma-proteins. Finally protein was shown experimentally to protect the liver from poisons. High protein diets were therefore advised. But neither low nor high protein diets seemed to have any noticeable effect on the progress of pre-eclampsia and they have been given up as unimportant. Another measure is the restriction of fluids and salt. In cases with severe œdema restriction of salt may be necessary. Sodium chloride excretion tests show that only a few patients with pre-eclampsia fail to eliminate salt adequately. In those patients who have a reduced salt excretion, restriction of salt in the diet can be of considerable help in getting rid of œdema. There are two ways of doing this. If the patient eats no added table salt, the daily intake of sodium chloride is reduced from 10 g. to 6 g. A salt-free diet, in which salt is not used in cooking, further reduces the daily intake to 4 g. The use of ion exchange resins has been lately introduced in an attempt to control the intake of sodium. The resin is given by mouth in doses of 50 to 75 g. daily. It combines in the alimentary tract with sodium ions, renders them insoluble, and liberates ammonium or potassium ions in exchange. Sodium is therefore prevented from being absorbed by the gut and is excreted in the fæces. So far this work is experimental. It relies for its effect upon the value of eliminating sodium from the body. It is usually unnecessary to restrict fluids if the salt intake is controlled.

New diuretic drugs acetazolamide, chlorothiazide and hydrochlorothiazide are said to be very effective in eliminating water, sodium and chloride from the body. A dangerous side-effect is the simultaneous elimination of potassium, which should be replaced during

therapy. Although certain claims have been made their value in the treatment of toxæmic patients awaits confirmation.

The diet on general nutritional grounds, therefore, should be a palatable mixed one, containing the proper supply of calories for a woman in bed and the correct proportions of protein, carbohydrate and fat when the needs of pregnancy have been taken into consideration. It may be necessary to supplement the diet with vitamins, calcium or iron if these are not adequate in amount. An occasional aperient may be necessary for the comfort of the patient.

Drugs to lower blood-pressure, such as *veratrum viride*, the ganglion-blocking agents, hexamethonium, pentolinium and mecamlamine, and reserpine have been tried without great success. The diuretic chlorothiazide has been used to potentiate the effect of these anti-hypertensive drugs which appear to be more successful in patients suffering from chronic hypertension than in those with toxæmia. Occasionally a patient responds to treatment but frequently after an initial fall the blood pressure returns to its former level within a few days.

The response to treatment and the progress of the case must be watched by twice daily observations on the condition of the patient, the amount of œdema, the quantity of urine excreted in the 24 hours, the height of the blood-pressure and the amount of albumin in the urine. After a few days' treatment the condition will show signs of improvement, remain unchanged or increase in severity. If the last occurs, and if, in spite of treatment, the physical signs become more pronounced, labour must be induced. If an improvement takes place, and the signs disappear, the pregnancy may be allowed to continue, but only if the patient is under the closest observation. Should there be no obvious change in the condition after some days' treatment, the decision is influenced by such factors as the severity of the toxæmia, and the period of gestation. Thus it would be unwise in the interests of both mother and child to continue medical treatment in a woman who had considerable œdema, in whom the blood-pressure remained in the region of 150 mm. Hg systolic and 110 mm. Hg diastolic. Termination of the pregnancy is urgently indicated if, in addition, she suffered from severe headaches and visual symptoms. If, however, the symptoms were not so severe, and if another 2 weeks would greatly decrease the risk of bringing into the world a small, weakly, premature infant, it may be justifiable to prolong the pregnancy for this length of time, and in exceptional cases for even longer.

The indications for the induction of premature labour can therefore be summarized as follows:—

1. In a mild case, more than 36 weeks pregnant, in which signs have persisted for 2 weeks in spite of treatment in hospital.

2. In a mild case as soon as the foetus is large enough if the disease has been present for more than 2 weeks.
3. In any case in which the physical signs are becoming worse with treatment.
4. In a moderately severe case in which there has been no improvement in a few days with medical treatment.
5. In a recurrent case as soon as the foetus is large enough, if intra-uterine foetal death has occurred in a previous pregnancy.

Late Results of Pre-Eclampsia

A woman who suffers from "pre-eclampsia or eclampsia in a first pregnancy may go through successive pregnancies without recurrence of the toxæmia. She may show no signs of having once had pre-eclampsia and she may not subsequently develop any related chronic disease. Nevertheless, she may get a recurrence of toxæmia in subsequent pregnancies or she may be left with a permanently raised blood-pressure.

Chronic hypertension as a sequel of pre-eclampsia

For many years it has been recognized that a chronic lesion may develop as the direct result of an attack of pre-eclampsia. Formerly it was believed that nephritis could arise in this way. We now think that nephritis very rarely, if ever, is caused by pre-eclampsia, whereas chronic hypertension is found in about one quarter of the patients who have suffered from pre-eclampsia. Several investigations involving the follow-up of large numbers of women have led to this point of view. It was shown in 1933 from an analysis of the Registrar General's returns that the percentage of deaths from Bright's disease and hypertension was the same in single as in married women. This was supported by two investigations in which the blood-pressures of 2000 parous women was compared with those of 2000 nulliparous women. It was found that the incidence of blood-pressures of 140/90 mm. Hg and above was greater in the nulliparous group of all ages. Finally, in 1942 the results of a follow-up of 144 women who had had pre-eclampsia were published. Not a single case of chronic nephritis was found although albuminuria was present for over two years in one patient until finally it disappeared. Fifty per cent. of these cases, however, had a blood-pressure permanently above 130/70 mm. Hg.

Thus it was concluded that nephritis does not occur as the result of pre-eclampsia but that hypertension is frequently found after it. It would also seem that the women who became hypertensive after pre-eclampsia were destined to do so anyway, or there would have been a higher incidence of hypertension in the married and parous

groups of women, some of whom, it can be safely assumed, must have had pre-eclampsia.

Moreover, there is no increase in the incidence of hypertension in parous women compared with nulliparous women at various ages. This means that pre-eclampsia does not cause the hypertension to appear at an earlier age. Search for a family history of hypertension in women with a blood-pressure which is raised after pre-eclampsia is often successful. There is no evidence that the duration of a toxæmia determines the incidence of chronic hypertension after the attack.

Although there is no dispute over the figures of the cases followed up, mentioned above, the comparatively low criterion of hypertension (130/70 mm. Hg) explains the high incidence of the malady following pre-eclampsia. Had a blood-pressure of 140/90 mm. Hg been selected as the standard the incidence of hypertension after toxæmia would have been the more generally accepted one of 25 per cent. While it is admitted that there may be a comparatively large number of potential hypertensives in the population, the majority never suffer from a blood-pressure which is high enough to give rise to symptoms. Although some of them die from cardiovascular disease they still enjoy a normal expectation of life.

While the pendulum has swung away from the old view that hypertension can be caused by toxæmia, obstetricians are continually seeing patients in whom severe hypertension seems without any doubt to have begun from the time of an attack of pre-eclampsia. Further work may show that this can happen.

Recurrent pre-eclampsia

In this condition pre-eclampsia recurs in successive pregnancies, although there may be one or more normal pregnancies intervening. These cases were formerly regarded as cases of occult nephritis. The kidney was presumed to have a low reserve of function which was only manifest by the added strain of pregnancy. Thus pregnancy was considered to be a test of renal function. But in the follow up of 144 cases of pre-eclampsia mentioned above none of the patients developed nephritis, since the albuminuria always disappeared.

Half the patients who suffer from pre-eclampsia in a first pregnancy, however, get another attack in their second and subsequent pregnancies. These may be the patients who are destined in time to develop chronic essential hypertension. If the blood-pressure between pregnancies is normal they are said to be cases of *latent hypertension*, although only 25 per cent. of women have been found with actual hypertension after pre-eclampsia.

CHAPTER XVII

HYPERTENSION AND ALBUMINURIA DURING PREGNANCY (*Continued*)

IMPENDING ECLAMPSIA AND ECLAMPSIA

Impending Eclampsia

IMPENDING eclampsia should be regarded as a more acute form of the condition known as pre-eclampsia, and, as the name suggests, it must be regarded as the acute illness that may precede, and tends to end in eclampsia. Comparatively few cases of pre-eclampsia terminate in this manner, though every case should be looked on as potentially eclamptic.

Symptoms and signs

The symptoms and signs of impending eclampsia are the same as those of pre-eclampsia, but all are more pronounced. Furthermore the onset of the condition is more sudden and the rate of progress more rapid. Thus, following a rapid and unexpected gain in weight, œdema suddenly appears and is likely to be found from the beginning in parts of the body other than the feet and legs. The face, hands, abdominal wall and possibly the vulva may be affected concurrently. If the patient has been lying on her back the œdema will be found in the lumbar region and over the sacrum. The quantity of urine secreted is considerably diminished and the amount of albumin is recognized as a cloud, 5 to 20 parts per 1000, instead of as a trace. The rise in the blood-pressure is more rapid and more pronounced, and readings such as 180 or 200 mm. Hg for the systolic and 140 mm. Hg for the diastolic may be discovered. Headache is very severe indeed; it is usually persistent and referred to the frontal region. The patient may complain of dimness of vision, diplopia, spots or flashes of light in front of the eyes and, rarely, sudden blindness. Retinal changes accompany the ocular signs. Ophthalmoscopic examination reveals œdema of the retina, exudates, which may be arranged in cotton-wool patches, and hæmorrhages. Retinal detachment may occur. Epigastric pain, nausea and vomiting can occur, and should be regarded as symptoms of serious liver damage. The liver is tender to palpation in these cases. These symptoms usually appear when the condition of pre-eclampsia is

well established. Occasionally, however, they may dominate the clinical picture from the outset, and thereby constitute one of the forms of vomiting of pregnancy. Patients under treatment rarely die in the impending eclamptic condition, unless some further complications such as intracranial hæmorrhage arise ; but when post-mortem examinations have been made in such cases, the kidneys and liver have shown lesions similar to those found in eclampsia. The biochemistry of the disease has been discussed in the section dealing with that aspect of the subject.

Treatment

In the first place the treatment of severe pre-eclampsia is preventive. Early detection of a rising blood-pressure, œdema and albuminuria, and rigid supervision of patients in whom albuminuria has occurred, on the lines indicated in the preceding chapter, will obviate the onset of the symptoms of impending eclampsia in a number of cases. Owing to the rapidity of onset in the majority of these patients, detection by routine antenatal supervision will be far less effective than in the case of pre-eclampsia. The patient should have been instructed to notify her doctor at once if she notices headache, dimness of vision, œdema, or vomiting at a late stage of pregnancy.

When the signs and symptoms of impending eclampsia are present there is urgent need for termination of the pregnancy. A patient who is admitted to hospital with a high blood-pressure in the region of 180 mm. Hg systolic and 100 mm. Hg diastolic, a considerable amount of albumin in the urine, up to 5 parts per 1000, and severe œdema but without the symptoms of headache, eye-signs, epigastric pain and vomiting, and in whom retinoscopy reveals no abnormality, should be regarded as a case of severe pre-eclampsia and induced straightaway if near term or treated conservatively for a day or two if not. She must be strictly confined to bed. Morphia gr. $\frac{1}{4}$ should be given on admission. Frequent observations of the patient must be made every 2 or 3 hours at first. The blood-pressure is recorded, the amount of albumin in the urine estimated, her urinary output measured and a careful watch kept for the occurrence of the above symptoms. Should such a patient get worse as shown by an increase in the physical signs, or should she develop the symptoms of impending eclampsia steps must be taken at once to terminate the pregnancy. If there is no improvement after two days or so the pregnancy should be terminated. Occasionally there is a considerable improvement with a great reduction in the severity of the toxæmia. Then the pregnancy may be allowed to continue if the baby is small but the case must be watched conscientiously at frequent intervals and with the greatest care. Meanwhile the treatment of pre-eclampsia, as outlined in the previous chapter, should be instituted.

The method of terminating pregnancy will depend upon the severity of the symptoms. When it has been decided to terminate, on account of a failure to respond to expectant treatment applied over a reasonable period, induction by rupture of the membranes may be adopted. But if the case is urgent and the danger of eclampsia imminent, as indicated by a rising blood-pressure, severe headache, vomiting and other premonitory symptoms, the delay involved in the usual methods of induction, together with the stress and strain of labour, may impose a grave risk of precipitating convulsions: in such cases delivery by Cæsarean section is advised, especially if the child is large enough to survive. The ideal method of procuring anæsthesia for the operation in these patients is by the use of nitrous oxide and oxygen.

Eclampsia

The ætiology and pathology of this disease have already been discussed. The incidence is about 1 in 1000 births. Eclampsia can be defined as pre-eclampsia complicated by the addition of fits. In the majority of cases, the fits begin before the onset of labour (ante-partum eclampsia). In the remaining cases, either labour begins with the onset of the fits (intrapartum eclampsia) or the first fit may occur in the puerperium (postpartum eclampsia). Eclampsia usually supervenes during the second half of pregnancy, and becomes more frequent as term is approached. A woman in her first pregnancy is more liable to this disorder, 75 per cent. of cases being in primigravidæ.

There is some association with hydramnios and twin pregnancies. In a series of 1524 cases of eclampsia the percentage of twin pregnancies was 4.7, whereas the average percentage of twin births is about 1.2 so that the incidence of eclampsia in twin pregnancy is about 4 times higher than in single pregnancy. Its occurrence has been reported in association with hydatidiform mole.

Symptoms and signs

Two distinct types of case can be described. In the one eclampsia occurs after only the briefest warning or without any warning whatsoever. Such cases of fulminating eclampsia constitute only about 10 per cent. of all cases. Their prevention is a practical impossibility. Œdema may be absent in these cases.

In the majority of cases, however, the condition of toxæmia has preceded the onset of the fits for some days, or even for weeks. Immediately prior to the first eclamptic fit some or all of the symptoms of impending eclampsia may become more pronounced. Thus headache

may be intense and constant, the œdema extends rapidly, visual disturbances appear and sudden blindness may supervene; there may be severe epigastric pain accompanied by vomiting, the quantity of urine secreted may decrease suddenly, the amount of albumin therein rise from 10 to 20 or 30 parts per 1000, and casts may appear in the urine; the blood-pressure may rise rapidly and pyrexia occur.

Eclampsia may come on at any time; it may occur while the patient is asleep. Rarely only a single fit occurs. This is the more likely to be the case if the fit be intrapartum or postpartum. As a rule it is a warning of others to follow, and the tendency is for the fits to recur. In mild cases the fits may occur only from one to three times; in some cases a very great number may be noted, and in the most severe cases 100 or more. They may follow each other so frequently as to appear to be almost continuous. This condition is called status eclampticus.

The Eclamptic Fit.—It is customary to describe the fit as occurring in several stages, but there is no pause between these stages. The patient is unconscious throughout the fit. In general terms the fit is similar to that in epilepsy, but an aura is absent.

Premonitory Stage.—As a rule the fit begins in the face. The patient will be noticed to roll her eyes, and there may be slight twitchings of the hands and face. This stage only lasts from 15 to 20 seconds, and is not always observed.

Tonic Stage.—The patient is rigid owing to the spread of the muscular contractions. The face is cyanosed from fixation of the chest muscles and the diaphragm. The tongue may be bitten between the clenched teeth. This stage does not last longer than half a minute, and is followed by the clonic stage.

Clonic Stage.—The muscles are now spasmodically contracted and then relaxed, so that this is the stage characterized by the convulsive movements. The jaw-muscles share in these movements, so that the patient may bite her tongue. By the jaw-movements the blood-stained saliva is beaten up into a froth, and the patient is said to foam at the mouth. The face is congested, the breathing stertorous, and the patient deeply unconscious. This stage may last from half a minute to 2 minutes. It is usually followed by a state of coma.

Stage of Coma.—After the convulsion is over the patient sinks into a comatose condition. This may continue for several hours, and then the patient awakes to consciousness. In other cases the coma may be only of short duration and may be broken by the occurrence of another fit. In severe cases the fits succeed each other in such rapid succession that there is no time for this stage.

Diagnosis from Epilepsy.—Occasionally an epileptic fit in a pregnant woman is confused with eclampsia. In epilepsy, however, there is usually a history of previous fits or scars on the face to suggest them ; and the signs of toxæmia, hypertension, albuminuria and œdema are absent.

Course of the Disease.—In a mild case of eclampsia, the fits may be few in number and not severe. Should this be the case, the condition of the patient will remain good provided that treatment is started early and is efficient. In the majority of cases, however, the outlook is not so favourable. As one fit follows another, the condition of the woman “rapidly deteriorates. The face becomes cyanosed and the pulse rapid. The temperature may be raised. The blood-pressure goes up considerably during the fit, but should fall after the attack has passed off. If the fits are frequent, this fall does not occur, thus forcing an additional burden on a weakened and overworked heart-muscle. Occasionally, cerebral hæmorrhage may occur during a fit, in which case the patient remains in deep coma until she dies.

As a result of the fit, the patient may bleed from injury to her tongue, due to the unconscious movements of the jaw. If the head is not turned to one side she may suffocate during the fit, but she is more liable to develop septic broncho-pneumonia at a later date owing to the inhalation of septic saliva into the air passages, especially if the teeth are decayed, or if there have been attempts at feeding. There is also danger of inhaling regurgitated stomach contents.

The convulsions are always followed by unconsciousness of a shorter or longer duration. When the patient wakes from this comatose state she may have no recollection of the fits, or even of the succeeding day or two, and this fact may be of importance from a medico-legal aspect.

Mental derangement follows in about 5 per cent. of cases, but such derangements are, as a rule, of a temporary character only. Some patients are confused for some time afterwards, and are unable to recognize friends.

The ocular symptoms as a general rule do not persist, as they may in cases of retinitis complicating nephritis with pregnancy.

In some cases the patient becomes markedly jaundiced. This may be noticed during or shortly after the convulsion. This sign is of grave prognostic significance, for it points to serious hepatic involvement.

Antepartum eclampsia is usually followed by the rapid onset of labour. The patient may die undelivered ; on the other hand,

she may recover without delivery taking place, and at a later date expel a dead foetus. But sometimes a live child is born prematurely or at term.

In intrapartum eclampsia the uterine contractions tend to increase in strength and frequency, and so delivery is hastened.

Postpartum eclampsia usually comes on within 24 hours after delivery. Cases reported as occurring later than this are probably cases of epilepsy or of cerebral vein thrombosis. It is not to be regarded as a benign form. Convulsions may succeed each other rapidly, and in such cases the maternal mortality is as high as 25 per cent.

Prognosis

The Mother. Immediate.—Eclampsia is a grave disease with an average mortality of between 5 and 10 per cent. The maternal mortality is about 1 in every 20,000 births in this country at the present time. It is gradually falling throughout the world. The maternal risks vary greatly according to the treatment adopted. If expectant methods are used early, the mortality can be lowered. When the immediate termination of pregnancy has been adopted as a routine by methods such as Cæsarean section or the insertion of bougies, the mortality is very high. It is a point of interest that eclampsia appears to be more serious in one country than another, and also in certain districts of the same country. A bad prognosis is indicated if the fits are numerous and succeed one another so rapidly that the patient does not recover consciousness in the intervals. If the fits are few in number, but the coma is deep and prolonged, the outlook likewise is grave. A pulse-rate that is rapid and increasing, the occurrence of hyperpyrexia, a persistently high blood-pressure, suppression of urine and the appearance of jaundice, all indicate a bad prognosis.

The prognosis is worst in the antepartum variety, and more serious in the intrapartum than in the postpartum form.

Cases which occur in a fulminating manner, without previous warning signs having been discerned, are worse than those in which there have been warning signs, and in which, as a consequence, treatment has been begun.

Eclampsia is graver when the condition supervenes in a patient who has old-standing kidney disease, or who has already borne many children. The prognosis in antepartum eclampsia is favourably affected by the death of the foetus. Usually the fits cease and rapid improvement in the patient's condition follows. This is not always the case, however, for instances occur in which eclampsia develops during the expulsion of a foetus which has evidently been dead for a considerable time.

The mother may die from asphyxia due either to cessation of respiration during the paroxysm, or to the entrance of saliva, stomach contents or blood into the larynx during the fit or while she is in a state of coma; she may die from œdema of the lungs, from cerebral hæmorrhage, heart failure, or later from septic broncho-pneumonia or uraemia.

The sight of patients who experience eye symptoms is usually completely recovered, even when there are considerable retinal signs.

Remote.—The question may be raised, if she recovers, as to what will happen in the event of her again becoming pregnant. There is a slight but definite risk that eclampsia may recur in a subsequent pregnancy, not necessarily in the pregnancy immediately following the first eclamptic one. There is a very real risk of permanent hypertension. It is very rare indeed for there to be any permanent impairment of renal function. The incidence of permanent hypertension may be as high as 30 per cent. after eclampsia.

The Child.—The prognosis is bad. Fifty per cent. of the children are born dead or die shortly after delivery.

The cause of death may be asphyxia, due probably to interference with the flow of the maternal blood in the placental site during the convulsions; or it may be the result of the toxæmia, accidental hæmorrhage, infarction of the placenta, or as a result of injury from obstetric manipulations carried out to hasten delivery.

Even if the child is born alive it may die later from prematurity, as labour so frequently occurs before full time. Convulsions in the infant may occur within a few minutes of delivery and are frequently ascribed to the presence of the toxin, or toxins, of eclampsia in the infant's blood-stream. While it cannot be denied that in some cases such convulsions may be due to this cause, in the majority of cases they are due to intracranial hæmorrhage, which, in its turn, is due to the manipulations and instrumentation whereby delivery is often effected.

Treatment

It has already been suggested that pre-eclampsia and eclampsia are best regarded clinically as stages of the same disease; the manifestations of the most severe stage, eclampsia, being the same as those of pre-eclampsia with the important addition of convulsions to the other signs and symptoms. A fatal termination in eclampsia is almost invariably due, either indirectly or directly, to the convulsions; at all events death during the pre-eclamptic phase of the disease is almost unknown, in the absence of any co-incident disease, parturitional or post-parturitional complications.

It necessarily follows that the first principle in treatment is to prevent the onset of convulsions; the second principle is to control the convulsions when they have already begun.

Prophylactic Treatment.

Fortunately in the large majority of cases pre-eclampsia first appears, gradually increases in severity and gives rise to the manifestations of impending eclampsia, before culminating in the convulsions which mark the third and most severe stage of a tripartite disease.

The measures which should be taken in the treatment of pre-eclampsia and impending eclampsia have already been described. By the early diagnosis and the prompt treatment of these two forerunners eclampsia becomes a preventable disease in a very considerable majority of cases.

Occasionally eclampsia has a fulminant onset with little or no warning, becoming established within a few hours. Careful prenatal supervision cannot prevent the disease in such circumstances.

Treatment after the onset of Convulsions.

The guiding principle in the treatment of established eclampsia is to reduce the frequency and severity of the convulsions, if possible to cause their cessation. This was a new approach to the problem when it was introduced in 1911 by the Russian obstetrician, Stroganoff. He relied for his original treatment on morphia and chloral. In 1937 he changed his sedatives to morphia and magnesium sulphate parenterally and claimed improved results with this method.

The convulsions are dependent upon external stimuli reaching and acting upon an over-excitabile, or easily excited, central nervous system. They can, therefore, be controlled, first, by reducing the receptivity of that system and, secondly, by preventing, so far as is possible, external stimuli from reaching it.

In as much as eclampsia is believed by some to be due to a toxic agent, or agents, produced by the products of conception, it might be expected that immediate and rapid evacuation of the uterus would be followed by equally immediate and rapid cure of the disease, as is the case in pre-eclampsia. This line of treatment, by Cæsarean section or by the routine induction of premature labour, has been tried in many obstetric schools all over the world. It has been almost universally abandoned, because the mortality following it is far higher than that which follows a policy of non-interference with the pregnancy. Similarly measures directed to the elimination of hypothetical toxins

from the intestinal tract by violent purgation or by high colonic lavage are to be deprecated. Such measures serve only to provide extra stimulation of the over-responsive central nervous system.

Removal to Hospital.

It is highly desirable that all cases of eclampsia be treated in hospital. If, therefore, the patient is first seen in her own home she should be removed to hospital as speedily and as gently as possible after the subcutaneous injection of morphia 0.016 g. (gr. $\frac{1}{4}$) and the oral or rectal administration of chloral 4.0 g. (gr. 60). It is best for the doctor to accompany his patient in the ambulance to hospital because he may have to introduce an airway and give oxygen or deal with the patient during another fit. Tribromethol has been shown to be a drug that is particularly useful for controlling fits during transport to hospital. In an emergency chloroform is useful, but being a liver poison it should be used sparingly. Occasionally cases are seen in which this course would involve greater risk than treating the patient in her own home. Some of the factors which militate against removal are imminent delivery, frequently recurring fits and an inordinately long distance from the patient's domicile to the nearest hospital. In cases in which labour is well advanced when the patient is first seen the question of removal assumes small importance, because rapid recovery after delivery can reasonably be anticipated. In cases in which removal seems to be contra-indicated owing to the severity of the symptoms, particularly of fits, it is wise to delay removal until some measure of control has been obtained by the administration of narcotic drugs. It is not usual in this country for inaccessibility to hospital to be the only bar to removal, but if a case does occur in such circumstances it is evident that the patient must be treated at home. A branch of the public health services has been established in most districts which provides for the treatment of obstetric emergencies by means of flying squads. Such a team consists of doctors and nurses prepared to undertake the immediate management of any case under domiciliary conditions.

Treatment during a Fit.

Provision must be made at once for the next eclamptic fit. The patient should be in bed, and the foot of the bed raised, especially if she is unconscious. She should be turned on her side, and the head so arranged that saliva and vomitus can dribble away. False teeth must be removed, and an efficient gag must be at hand. The handle of a spoon wrapped round with a handkerchief will serve for this purpose. The gag is used in order to prevent the patient from biting her tongue during convulsive and unconscious movements.

After the fit has passed off, the head must be kept turned on to one side, so that blood or saliva may run out of the mouth and none may enter the respiratory passages, for if this occurs the patient may be suffocated, or run the risk of septic broncho-pneumonia. If there is much mucus, or if the respiration is bubbly or laboured, the head must be brought over the edge of the bed with the face downwards and the back of the pharynx swabbed. Unless these precautions are observed it is possible for the patient to be suffocated and to drown in her own secretion. It is therefore absolutely essential that a trained nurse should constantly be with the patient.

Treatment to control the Convulsions.

Whether the patient is moved to hospital, or otherwise, treatment must be carried out in accordance with the two principles already enunciated, namely a reduction in the receptivity of external stimuli by the central nervous system and the prevention, so far as is possible, of external stimuli from reaching that system.

The first desideratum is effected by giving anti-convulsant drugs such as morphia and chloral hydrate in large doses, so that the patient is kept under their influence throughout treatment and for 24 hours after cessation of the fits. At the onset of treatment the patient should be given morphia 0.016 g. (gr. $\frac{1}{4}$) by subcutaneous injection and chloral hydrate 4 g. (gr. 60), in 2 oz. of water per rectum: usually she becomes quiet and sleeps within an hour of the administration of these drugs. They should be repeated when she shows signs of waking, commonly about 3 hours after the initial dosage. But if the fits continue a second dose of both drugs should be given before the lapse of 3 hours. Further doses are given when the effect of the previous dose begins to wear off, as indicated by returning consciousness and movement. The third and subsequent doses of morphia and chloral hydrate are usually smaller than the first and second, 0.01 g. (gr. $\frac{1}{6}$) and 2 g. (gr. 30), of each respectively, ordinarily suffice to keep the patient narcotized. During the first 24 hours of treatment 2 grains of morphia and 240 grains of chloral hydrate can safely be given, these figures representing the average dosage required in a case of some severity.

During treatment two important matters require consideration. The first relates to the administration of fluids, the second to the catheterization of the bladder.

It is generally agreed that if the patient is sufficiently conscious she should be given frequent small drinks of water and glucose. When fluid cannot be taken by the mouth, some obstetricians advocate its administration rectally, others subcutaneously and yet others intravenously. While the necessity for maintaining an adequate fluid

intake cannot be denied, it is important to remember that the disturbance of the patient involved by giving fluid by these methods may well be more harmful by provoking fits than withholding it altogether, particularly during the first few hours of treatment.

Patients are apt involuntarily to void urine while unconscious ; it is therefore desirable to insert a self retaining catheter into the bladder and to release it at regular intervals. This avoids the unpleasant stimulus to fits by a wet bed and affords valuable information regarding the amount of urine secreted. A few whiffs of chloroform should be given if passing the catheter causes fits.

In the large majority of cases treated on these lines recovery takes place within 24 to 48 hours of the commencement of treatment. It is indicated by gradually returning consciousness and the secretion of large quantities of urine.

Although chloroform may itself injure the liver it is such an excellent drug for controlling eclamptic fits that there is no need for hesitation over its use on the understanding that due caution is observed.

The second desideratum, to prevent external stimuli reaching the patient's central nervous system, is met by nursing the patient in a quiet darkened room. Direct light must not be allowed to fall on the patient's face. Noise must be eliminated, even that produced by leather soles on a wooden or stone floor : to this end a room at the end of a corridor should, if possible, be chosen, thus preventing stimulation by the noise of traffic outside the door ; the attendants should wear shoes with rubber soles and in urban districts the windows of the room should be double. Draughts of air should be excluded by screens placed between the patient and the door. It has already been indicated that any necessary manipulation or examination of the patient should be performed when the morphia is having the maximum of its desired effect or, if necessary, under light chloroform anaesthesia, except in patients who are too comatose to be disturbed by them.

TREATMENT TO CONTROL THE CONVULSIONS BY DRUGS OTHER THAN MORPHIA AND CHLORAL

Tribromethol (Avertin).—This method of treating eclampsia was introduced in 1947 for patients who had to travel a long way by ambulance to hospital. "Freshly prepared" tribromethol is given per rectum in water at 40° C.: 0.088 ml. per kg. of patient body-weight is given. The dose can be repeated in 3 hours if necessary and again a third time. Apart from the use of tribromethol the principles of the Stroganoff treatment are carried out. It is found that the patients sleep so deeply under the influence of the drug that the precautions

taken to prevent external stimuli from reaching them may be relaxed to a certain degree. This variation of the original Stroganoff treatment is probably the most successful discovered so far.

Magnesium sulphate and morphia.—This treatment was advocated by Stroganoff in 1937. He claimed that his results were better than with morphia and chloral. Magnesium sulphate has a depressant effect upon the central nervous system when given parenterally. It is used here as a sedative. Morphia gr. $\frac{1}{4}$ is given at the start of the fits. Half an hour later 40 ml. of 15 per cent. magnesium sulphate at body temperature are given subcutaneously. Another dose of morphia is given 2 hours later. Twenty ml. of magnesium sulphate solution are given 6, 12 and 20 hours after the start of fits. The subcutaneous injections of magnesium sulphate are made under light chloroform anæsthesia. As an alternative 10 ml. of a 50 per cent. solution of magnesium sulphate can be given intramuscularly initially, followed by 5 ml. 6-hourly for 24 hours and then 5 ml. twelve-hourly for the second 24 hours.

Veratrum viride.—This drug produces a fall in blood-pressure by reducing peripheral resistance through vasodilatation in the limbs. Injections of 5 to 10 minims of the drug are given at 20 minute intervals so that the blood-pressure is kept below 150 mm. Hg systolic and the pulse-rate at 80 per minute. Coincident with the fall in blood-pressure the fits become controlled and coma may be relieved. Veratrum may produce serious collapse owing to its cardiac depressant properties and nausea and vomiting are frequent. It is dangerous to give the drug to patients with a blood-pressure below 140 mm. Hg.

Other methods.—Various other drugs have been used to control the convulsions of eclampsia: thiopentone (pentothal) intravenously; paraldehyde, 6 drachms in olive oil per rectum; intravenous injections of hypertonic glucose, 500 ml. of a 10 to 20 per cent. solution, which are said to reduce intracranial pressure; intravenous injections of calcium gluconate, 10 ml. of 10 per cent. solution may be given to protect the liver.

When the fits have been controlled for 24 hours another fit is most unlikely to occur. When there has been no fit for 48 hours the disease is cured. It may still be necessary to induce labour, however, by rupture of the membranes.

THE TREATMENT OF SPECIAL SYMPTOMS

Hyperpiesia. When the height of the blood-pressure is excessive and sustained and a marked drop does not occur in the intervals between the fits, the outlook is extremely grave. In these circumstances venesection should be performed, and 300 to 450 c.c. (10 to

15 ounces) of blood removed. A further 300 c.c. (10 ounces) may be removed 12 hours later if the condition of the patient is temporarily improved.

Cardiac Failure and Cyanosis.—When the patient begins to exhibit obvious signs of a failing circulation, as evidenced by a rising pulse-rate, and enlarging area of cardiac dullness and cyanosis, immediate steps must be taken to relieve the work of the heart. Venesection should be performed as outlined above. Oxygen must be given to the patient continuously if she is cyanosed, and coramine, 1 ml., should be injected every 2 hours until the immediate danger is over.

Œdema.—If the œdema is excessive, the patient is liable to the danger of extensive œdema of the lungs. In such a case, there is great danger in augmenting the intake of fluids whichever way they are given. So long as such œdema is present, the fluid intake will have to be limited. Œdema of the vulva, so excessive that it causes difficulty in the performance of a vaginal examination or delivery of the foetus, should be treated by puncture. Whereas it is important that the patient should be kept warm, sweating is contra-indicated, as there is no evidence that the toxic agent leaves the body in the sweat, and the process certainly weakens the patient and seems likely to increase the number and severity of the fits. Medicinal means to produce sweating, such as the use of pilocarpine, are dangerous, as they further weaken the action of the heart.

Hyperpyrexia.—Excessive rise in the temperature is weakening to the patient and should be treated by tepid sponging, which must be repeated if necessary.

Suppression of Urine.—A diminution in the urinary output is not unusual during the acute stage of the disease; recovery being heralded by diuresis which should be encouraged by a liberal intake of fluid.

In some cases suppression of urine occurs and may be due to bilateral cortical necrosis of the kidneys. The treatment of cases of anuria is considered in the next chapter.

Obsettric Treatment.—The question of the obstetrical treatment of eclampsia has led to much discussion and difference of opinion. There have been in the past two entirely opposed views; the one claimed that the pregnancy should be terminated at once, and the other that obstetrical interference was unnecessary unless medical measures failed or the patient was advanced in labour.

In favour of the former view was the experience that, in most cases, recovery was rapid after the uterus was emptied. In consequence, it was argued that the correct treatment was to empty the uterus with as little delay as possible. Hence measures for induction were

employed, and these proving too slow, more rapid measures, such as accouchement forcé (*i.e.* the delivery by forceps of the fœtus through a cervix that is incompletely dilated) and Cæsarean section, were employed. Accouchement forcé is now universally condemned ; moreover there is now sufficient evidence to show that the treatment of eclampsia by the routine performance of Cæsarean section is a dangerous practice. Such a procedure is accompanied by a far higher mortality than that of a policy of non-interference. The pregnancy, therefore, should be ignored during the acute stage of the disease. Extra narcotic drugs may be necessary to prevent the pains of labour from stimulating fits.

Pregnancy should be terminated by rupture of the membranes under certain conditions. Thus, if the fits have been got under control and the condition of the patient appears greatly to be improved, it should be done. When labour supervenes morphia, chloral hydrate or paraldehyde should be used freely, as the fits may recur. At all times in a patient who is suffering from eclampsia, the onset of the expulsive pains of the second stage of labour indicates an anæsthetic (preferably nitrous oxide and oxygen or pudendal block) and the delivery of the child by forceps.

CHAPTER XVIII

HYPERTENSION AND ALBUMINURIA DURING PREGNANCY (*Continued*)

ESSENTIAL HYPERTENSION AND NEPHRITIS IN PREGNANCY. RARE TOXÆMIAS OF PREGNANCY

Essential Hypertension in Pregnancy

THIS condition is difficult to define. Women with a blood-pressure of 140 mm. Hg systolic and 90 mm. Hg diastolic or more before pregnancy should certainly be included. In patients with essential hypertension in pregnancy the blood-pressure is liable to rise and the incidence of albuminuria, *i.e. superimposed pre-eclampsia*, is about seven times the normal. When pre-eclampsia becomes superimposed on essential hypertension as shown by albuminuria, the patient is liable to the same complications as in uncomplicated pre-eclampsia; to wit eclampsia, death of the foetus *in utero* and accidental hæmorrhage. In addition a large rise in the blood-pressure involves a risk of cerebral hæmorrhage.

Diagnosis.—If the patient is known to have had a high blood-pressure before pregnancy there is no difficulty in diagnosis. Similarly the earlier in pregnancy hypertension is found the more likely is the raised blood-pressure to be due to essential hypertension. In mid-pregnancy there is difficulty in diagnosing between early pre-eclampsia and essential hypertension. To choose an arbitrary moment in pregnancy, such as the end of the 20th week, and to consider hypertension found before that date to be due to essential hypertension and after that date to be due to pre-eclampsia is only an approximation to the truth. It may, however, be the only means of coming to a conclusion, short of making observations after the pregnancy. The clinical signs of long-standing hypertension, such as cardiac enlargement and retinal arterio-sclerosis, are definite evidence of essential hypertension, but they are seldom found in pregnancy. Similarly there is no renal impairment.

Course.—Sixty per cent. of cases of essential hypertension have a progressive rise in blood-pressure after the 24th week, and about

20 per cent. develop albuminuria. If the blood-pressure is 150/100 mm. Hg or more at the onset of pregnancy the chance of producing a viable child is only one in three. About half the cases show a fall in blood-pressure in mid-pregnancy. This may lead to errors in diagnosis if the patient is seen for the first time with a lowered blood-pressure. When it rises again she may wrongly be thought to be suffering from pre-eclampsia. When albuminuria develops the prognosis for the foetus is poor, because very often the albuminuria appears before viability about the 32nd week. In such a case prolongation of the pregnancy increases the risk of death of the foetus *in utero* from accidental hæmorrhage or from placental insufficiency. The babies, however, are often unduly small for their intra-uterine ages. Thus termination of pregnancy before the 35th week leads to the delivery of a small and very premature infant, unlikely to survive. Nevertheless in patients in whom there is neither albuminuria nor an undue rise in the blood-pressure the outlook for the child is good.

Treatment.—Patients suffering from essential hypertension should be advised to rest. In severe cases this should be carried out in hospital so long as the blood-pressure remains very high. Apart from rest there is little that is of avail. Neither restrictions in diet nor the administration of drugs are of assistance. A nocturnal sedative may help. Hypotensive drugs such as the ganglion-blocking agents hexamethonium, pentoinium and mecamlamine, veratrum viride and reserpine have been used in an attempt to prolong pregnancy until the foetus has grown large enough to survive after delivery, but the results have been disappointing. Weekly or fortnightly tests of the urine of out-patients for albumin should be done. As soon as albuminuria is detected the patient must be admitted to hospital; premature labour should be induced so soon as the foetus is large enough, if there is albumin in the urine, but this may necessitate allowing the pregnancy to continue for several weeks in a mild case in spite of albuminuria, so that the baby may grow.

Labour should be induced by rupture of the membranes. The membranes may even be ruptured before albumin appears in the urine in order to get a live baby if the patient is elderly or if she has had previous stillborn foetuses.

Prognosis.—In about a third of the cases examined after pregnancy the blood-pressure remains permanently raised above the level before pregnancy. The outlook for the foetus is much worse if albuminuria supervenes. About a third of patients have live babies.

Malignant hypertension

The malignant type of the disease is characterized by very considerable and progressive elevation of the blood-pressure. Unlike the benign type it is associated with evidence of impaired renal function as shown by albuminuria and albuminuric retinitis. The prognosis for both mother and child is very bad.

Fortunately these cases are very seldom seen in pregnancy. Patients should be strongly advised against conception; if it occurs therapeutic abortion should be advised.

Nephritis in Pregnancy

Acute nephritis

Acute nephritis is now known as acute Type I nephritis. It is a disease in which there is a pyrexial illness of acute onset with vomiting, pain in the loins, oedema of the face and hands and gross hæmaturia. It is usually preceded for 2 or 3 weeks by an acute streptococcal infection, such as tonsillitis or scarlet fever. It is very rarely seen in pregnancy, but if it occurs miscarriage or premature labour may follow. Most cases of acute Type I nephritis recover but a small proportion, about 10 per cent., develop chronic Type I nephritis with a slowly progressive hypertension and eventually renal failure. Thus the majority of pregnant patients who give a history of acute nephritis in the past will be found to be normal.

Chronic nephritis

Two varieties of chronic nephritis are seen in pregnancy and both are rare. Of the two, chronic Type I nephritis is seen more frequently. This is a condition which follows a recognizable attack of acute nephritis and is characterized by slowly advancing hypertension and albuminuria. The course of the disease, uncomplicated by pregnancy, is about 20 years.

The other, less common, variety of chronic nephritis is known as Type II. This form of the disease has no acute stage. Oedema of the ankles and gross albuminuria with little or no hypertension are already established by the time the diagnosis can be made. It is usually fatal within 10 years. Women suffering from this type of nephritis in whom there is renal failure are too ill to become pregnant. It is probable that both types are adversely affected by pregnancy, but many of the patients are infertile or abort, if pregnant. Of those in whom pregnancy continues the chances of a live baby are poor unless the disease is mild.

Diagnosis.—The sudden febrile illness of acute Type I nephritis is usually straightforward to diagnose. Chronic Type I cases give a history of such an attack, but apart from this they may be indistinguishable from essential hypertension in the early stages, unless albuminuria is present. Type II cases may give a history of albuminuria at a previous medical examination. The early onset of albuminuria in pregnancy at a stage too soon for pre-eclampsia is an important point in the diagnosis. In addition to slight albuminuria Type I cases have hypertension, while Type II cases have very marked albuminuria and severe œdema but hypertension may be absent or slight. Casts may be found in the urine but are not present in early cases. Such features as cardiac enlargement, which indicates long-standing hypertension, albuminuric retinitis and renal failure, shown by the passage of large quantities of dilute urine and a blood-urea above the normal pregnancy value of 30 mg. per 100 ml., are rare phenomena in pregnancy, being found only in advanced cases.

Course.—Chronic nephritis may be a cause of infertility and, when conception takes place, of abortion. Pregnancy is always liable to cause an exacerbation of the signs of hypertension, albuminuria and œdema. In advanced cases renal failure may be precipitated. Pregnancy may be complicated by accidental hæmorrhage, eclampsia or cerebral hæmorrhage. There is always considerable risk to the foetus of death *in utero*. This is assumed to be due to placental insufficiency because the placenta is small and grossly infarcted. In spite of this serious trend surviving babies are delivered in about half the cases without acceleration of the progress of the nephritis. This outcome is more likely in the less severely affected patients.

Treatment.—Termination of pregnancy is indicated in patients with renal failure, albuminuric retinitis or rapidly increasing physical signs. The risk to the mother is too great and the foetus is certain to die if the pregnancy is allowed to continue. In most advanced cases of chronic nephritis termination of pregnancy is indicated. Abdominal hysterotomy has to be done after the 12th week of pregnancy, and the opportunity is usually taken to sterilize the patient. Before the 12th week it is possible to terminate pregnancy *per vaginam*.

In a few cases of mild chronic nephritis, probably less than half, it may be decided to allow the pregnancy to continue. Chronic nephritis is a serious and progressive disease without the addition of pregnancy, but the successful delivery of a surviving child may make the risk worth while. A very careful watch must be kept for deterioration, as shown by an increase in the blood-pressure, œdema or albumin-

uria. Adequate rest is important. A nourishing diet is advised and anæmia is treated. The more severe cases must be in hospital under more constant supervision. As soon as the foetus is viable, about 34 weeks, premature labour should be induced. Owing to the insufficiency of the placenta Cæsarean section is often performed in the interest of the foetus. In multiparæ rupture of the membranes and vaginal delivery may be successful.

Rare Toxæmias of Pregnancy

Ptyalism, pruritus of pregnancy, herpes gestationis

On rare occasions certain symptoms may appear in pregnancy without any apparent cause. They have loosely been regarded as toxæmias but no toxin has ever been isolated. Excessive salivation, known as *ptyalism* occurs, and may be quite severe. Treatment with 15 minims of tincture of belladonna t.d.s. by the mouth may be tried. Generalized skin irritation, *pruritus of pregnancy*, occurs in the absence of a skin lesion. Symptomatic treatment with lotions and anti-histamine drugs may help. *Herpes gestationis* is a rare disease in which an herpetiform rash appears in pregnancy. It may be very severe. It is difficult to treat.

CHAPTER XIX

VOMITING DURING PREGNANCY

EARLY MORNING SICKNESS, HYPEREMESIS GRAVIDARUM, ACUTE YELLOW ATROPHY AND OBSTETRIC YELLOW ATROPHY

SLIGHT vomiting occurs in almost 50 per cent. of women in normal early pregnancy, being more frequent in primigravidæ than in multiparæ. Very rarely the vomiting may be more severe and in the most exceptional cases the life of the patient may be endangered. The causes of vomiting in pregnancy may be classified as follows:—

1. Vomiting due to a disease complicating pregnancy, *e.g.* pyelitis, hiatus hernia, peptic ulceration, intestinal obstruction, acute appendicitis.
2. Early morning sickness.
3. Hyperemesis gravidarum.
4. Vomiting accompanied by jaundice in pregnancy.
 - (a) Hyperemesis gravidarum followed by liver failure.
 - (b) Infective hepatitis, homologous serum jaundice and acute yellow atrophy of the liver.
 - (c) Obstetric yellow atrophy of the liver.
 - (d) Delayed chloroform poisoning.

Vomiting due to diseases complicating pregnancy

Vomiting in pregnancy may be due to a disease which may be looked upon as an accidental complication of, and not the result of, pregnancy, such as that due to the onset of an acute specific fever, to gastritis, to a peptic ulcer, to pyelitis, or to a cerebral tumour. Care must be taken not to pass over a case in which the vomiting is really the result of appendicitis or intestinal obstruction. On the other hand, the patient may vomit simply because she is pregnant and there is no accompanying organic cause to explain it.

One cause of vomiting, especially in the later weeks of pregnancy, is a diaphragmatic hiatus hernia as a result of the increase in abdominal contents. The hernia can be demonstrated by a barium meal X-ray examination; it shows part of the stomach entering the chest through the œsophageal hiatus. The patient is advised to sleep propped up in

bed with pillows and reassured that the condition will give rise to no further trouble once the pregnancy is over.

Early Morning Sickness

One of the earliest diagnostic criteria of pregnancy, this symptom, coming on about the 6th week, consists of nausea on waking in the morning and the vomiting of the resting gastric juice. It may persist until the patient has vomited her breakfast but the condition improves later in the day. Some degree of nausea may persist throughout the day, but not sufficiently to prevent an adequate intake of food and fluid. The sickness disappears about the 14th week. About 50 per cent. of all pregnant women suffer from morning sickness. It is treated by assuring the patient that it is only temporary. The patient is advised to have a biscuit or a piece of dry toast in the morning before rising. Breakfast in bed and frequent small carbohydrate meals may help. (For further details see Treatment of Hyperemesis Gravidarum, p. 206.)

Hyperemesis Gravidarum

A certain degree of nausea and vomiting commonly affects the pregnant woman in the early part of her pregnancy from about the 6th to the 14th week, after which these symptoms usually subside. Sometimes, however, during this time the symptoms are much more severe and the vomiting persists. All gradations occur from the mild cases of ordinary morning sickness to vomiting which is so persistent and severe that it imperils the patient's life. The term hyperemesis gravidarum is applied to those cases in which the vomiting becomes so frequent that it interrupts the daily routine of the patient or affects her health. The vomiting may be so extreme that she is unable to retain any food or fluid and becomes wasted and dehydrated in consequence.

Frequency.—Nausea and the slighter degrees of vomiting occur in more than 50 per cent. of pregnant women, being more frequent among primigravidae than multiparæ. Vomiting of such severity as to merit the term hyperemesis is rare.

Ætiology of Hyperemesis Gravidarum.—The exact ætiology of this type of vomiting is unknown. Its persistence in some cases is due to psychological factors. That its primary onset is not entirely due to auto-suggestion is indicated by the observation that pregnant women frequently complain of nausea and vomiting before they are

aware of their pregnancy, *e.g.* before a period is missed or when conception has occurred during a period of amenorrhœa associated with lactation. Moreover, it would be clearly unjustifiable to account for early morning sickness on the grounds of anxiety or hysteria in the majority of pregnant women.

It has been contended that the physiological degrees of nausea and vomiting of pregnancy are reflex in origin, and that the pathological persistence and accentuation of the condition are essentially psychological. While the available evidence supports the latter part of this contention in a few cases, the evidence in favour of a reflex origin is at present unconvincing. Many cases of cure have been recorded in which the vomiting has ceased after the replacement of a retroflexed gravid uterus. Such cases were formerly put by themselves in a group known as the reflex; but there is no proof that the vomiting is brought about reflexly in this way; for such misplacements are often present without vomiting, and vomiting may occur in their absence. It is far more probable that the cure may be attributed to the mental effect on the patient of the treatment adopted.

Many observations afford evidence that continued vomiting may be the manifestation of a neurosis. Among these may be mentioned the fact that evidence of anxiety is sometimes present in such cases, and that the true nature of the vomiting may be shown by its cessation when the patient is removed from her home surroundings. Thus patients who have been anxious to have a child have been cured on the mere threat of terminating the pregnancy. This view is further supported by the large number of different drugs which have had their vogue and adherents. The cure of a symptom by suggestion, however, is not proof of its psychological origin. Incidentally, an unwelcome pregnancy raises an obstacle to treatment; as, in this type of case, an element of malingering complicates the psychological factor, and the patient is essentially hostile to psycho-therapeutic measures.

There is no evidence for a specific toxin which causes hyperemesis. Nor is there any biochemical abnormality at the onset of the condition. Whatever biochemical changes are found can, in every case, be accounted for by the vomiting and the consequent starvation and dehydration. Toxic effects upon the liver and brain in the most severe and fortunately very rare cases are considered more likely to be due to deprivation of essential biochemical factors than to poisoning. The comparatively high incidence of hyperemesis in cases of hydatidiform mole and twins has led to the theory of an endocrine excess as the cause of vomiting. In these conditions an excess of chorionic gonadotrophin is produced and the time in pregnancy at which hyperemesis occurs coincides with the time of greatest secretion of this hormone.

Effects of Hyperemesis Gravidarum.—These are essentially dehydration and starvation. In the milder cases, vomiting may be frequent and persistent. Although the patient is incapacitated and miserable as a result, her health remains unaffected.

In more severe cases, water depletion leads to loss of weight, a dry inelastic skin and dry tongue, sunken eyes, fall in blood-pressure, rise in pulse-rate, oliguria and constipation. Starvation further reduces the weight of these patients and accounts for their prostration and general muscular weakness. Carbohydrate depletion occurs relatively soon as the result of vomiting in the pregnant woman. This may be due to the added demands of the foetus. For energy she has to call upon her fat reserves. But the normal rate of metabolism of fat in the liver requires a certain amount of available carbohydrate. In the absence of carbohydrate fats are broken down at so great a rate that the breakdown products, aceto-acetic acid, β -hydroxybutyric acid and acetone, accumulate in the blood. These fat metabolites are called ketone bodies. Acetone appears in the breath and can be detected in these cases by its characteristic smell. Acetonuria is diagnosed by Rothera's test on the urine or by a positive reaction with ferric chloride.

Excretion of ketone bodies in the urine helps to prevent a change in the pH of the blood and inevitably means the passage through the glomeruli of a highly acid renal filtrate. In the renal tubules ammonia is secreted and neutralizes the acid in the urine by the formation of ammonium salts. The percentage of nitrogen in the urine excreted as ammonia is called the ammonia coefficient. Normally it is about 5. A rise in the ammonia coefficient occurs in ketosis. It is said to be a measure of the degree of ketosis. But the increase in the ammonia coefficient in hyperemesis is not entirely due to the passage of acids through the kidneys because the total nitrogen excreted in the urine falls in starvation and thus the ammonia percentage tends to rise.

In the most extreme cases the continual retching and vomiting, rising pulse-rate and falling blood-pressure, weakness, exhaustion and emaciation lead to severe deterioration in the patient's condition. Death may take place from heart failure or may be precipitated by surgical intervention and shock. Fatal complications occur in the nervous system and jaundice may herald the onset of liver failure. Lesions occurring in the central nervous system and the liver are in all probability due to starvation. Nervous lesions include a condition known as Wernicke's encephalopathy (in which nystagmus, diplopia, cranial nerve palsies and a peculiar mental change are associated with hæmorrhages in the hypothalamus and brain stem), peripheral neuritis and Korsakoff's syndrome. These are all thought to be due to

deprivation of vitamin B complex. The syndrome is identical to the one found in chronic alcoholism. Pronounced starvation changes may be found in the liver, but it is not clear why they should ever of themselves prove fatal.

Pathology.—Few patients suffering from the milder forms of vomiting die and therefore the description of the pathological lesions is founded on the examination of severe cases.

Liver.—The liver is shrunken and yellow. Various microscopic lesions have been described. Patients who die with massive necrosis of the liver are probably cases of true acute yellow atrophy, conditioned, perhaps, by protein deficiency, in particular deficiency of the amino-acids cystine and methionine, which has been shown to be associated with an increase in the incidence of the disease. They are therefore instances of a very rare disease in which pregnancy is co-incidental. Centrilobular zonal necrosis of the liver occurs only when chloroform has been given to a patient with hyperemesis. It has been shown that the liver lesion of pure hyperemesis gravidarum is simply fatty infiltration of liver cells without any necrosis. The fat globules are large and centrilobular in distribution. Such a lesion would not seem to contribute to the death of the patient and should be regarded as an incidental finding, due to vomiting and not causing it. Women who die from associated diseases later in pregnancy, such as pyelitis, show the same change in the liver if vomiting has been a prominent feature. Moreover, in about half the fatal cases of hyperemesis the histological appearances in the liver are normal.

Kidneys.—The kidneys may not show any change. In some cases there is a fatty change in the cells of the first convoluted tubules. This is not found when glucose has been given in adequate amounts before death. The lesion is therefore thought to be the result of acidosis.

Heart.—A constant finding is a small atrophic heart. The degree of atrophy is in accordance with the duration of vomiting. It would partly explain the fall in blood-pressure and the rise in pulse-rate. The reason for this atrophy is not clear.

Brain.—In a few cases in which it has been specially looked for the lesions of Wernicke's encephalopathy have been found. These consist of hæmorrhages in parts of the hypothalamus, in the corpora mammillaria, the corpora quadrigemina, the walls of the third ventricle, the floor of the fourth ventricle and the olivary nuclei. These lesions are associated with specific physical signs in the central nervous system, such as nystagmus, cranial nerve palsies and mental apathy.

Symptoms and signs.—In hyperemesis gravidarum the symptoms begin as in the ordinary early morning vomiting of pregnancy. The vomiting, however, either persists beyond the 14th week, the date at which the ordinary vomiting usually stops, or becomes more severe. The patient is sick after every meal and also between meals, she is unable to absorb nourishment and her rest may be disturbed on account of the continual retching and the vomiting at night.

If, in spite of the distressing symptoms, she is absorbing some fluid and nourishment, her general health may be unimpaired. Her weight is stationary; her pulse-rate is 80 per minute and her systolic blood-pressure 120 mm. Hg; the urine contains no ketone bodies and the ammonia coefficient is 5. The vomiting may be worse and may continue for weeks so that the patient becomes dehydrated, wasted and so exhausted that her condition is rendered serious. In this case her pulse-rate rises to about 100 per minute, and her systolic blood-pressure falls to 100 mm. Hg. She has lost weight and her dry skin, sunken eyes and dry tongue show that she is becoming dehydrated. She is constipated. There is acetone in the breath. The urine, small in amount and concentrated, contains ketone bodies and the ammonia coefficient rises to 10. In a very grave case emaciation increases; material like coffee grounds is vomited, the pulse-rate is likely to be 120 or more per minute, the temperature becomes raised and the systolic blood-pressure may fall to 80 or 90 mm. Hg. Ketone bodies are present in the urine; albuminuria may appear; the ammonia coefficient may rise to 20 and although the blood-urea is increased the total daily excretion of nitrogen falls. Unless pregnancy is terminated in such a case, liver failure, as shown by the onset of jaundice and the appearance of bilirubin and urobilin in the urine, may supervene, or central nervous signs may develop, indicating in some cases Wernicke's encephalopathy. Involvement of the central nervous system is shown by the development of nystagmus, ocular or other cranial nerve palsies, such as paralysis of the soft palate producing nasal regurgitation on swallowing, apathy and drowsiness, or, occasionally, excessive loquacity, diplopia or even blindness with optic neuritis. Mental changes of the Korsakoff type occur, in which the patient is confused and deluded with a loss of memory for recent events. Peripheral neuritis causes tenderness of the muscles of the legs and subsequently foot-drop and wrist-drop. Nervous complications may occur some days after vomiting has ceased. Apart from jaundice, liver failure is followed by pyrexia, lethargy, coma and death. It must be again stressed that severe and complicated cases of hyperemesis are fortunately very rare. Most cases respond to treatment.

Diagnosis.—The first essential in diagnosis is to make sure that the vomiting is not due to any of the associated forms already mentioned. This may be determined by a careful investigation into the history of the vomiting and a general examination of the patient. It is of importance to consider the possibility of poisoning by abortifacients.

Prognosis.—The prognosis is satisfactory if the patient is properly managed and it is rarely necessary to empty the uterus. Although artificial termination of pregnancy may prove necessary as a means of saving the patient's life, it may imply that the case has been mismanaged in its earlier stages, and therefore represent a confession of failure. A case should not be regarded as trivial since neglect or unintelligent treatment may determine a rapid progress of the condition and eventually lead to death. A recurrence of the vomiting is liable to take place in succeeding pregnancies.

Treatment.—The ordinary form of vomiting which occurs during the early months of pregnancy can be treated, usually with success, by means of simple remedies. The patient should be told to take a dry biscuit or piece of toast as soon as she wakes, so that she is not allowed to feel any faintness which might ensue were she to wait for her breakfast hour. She should be advised to take her breakfast in bed, and remain in the recumbent position for about half an hour afterwards. Even if she is sick, it is better for her to take food rather than to starve herself. She should be encouraged by the knowledge that many pregnant women complain of vomiting and nausea, but that the symptoms are only of a temporary character.

She is advised, if the vomiting tends to recur during the day, to take frequent small meals of a carbohydrate nature; not to mix solid and fluid, and to avoid large meals and fats. Drugs which may be of use are phenobarbitone 60 mgm. (gr. 1 b.d.), ancolan, ancloxin, avomine or dramamine 25 mgm. b.d. or t.d.s. and anthisan 100 mgm. b.d. Some patients are improved by the administration of an alkaline mixture containing magnesium trisilicate 2 gm. (gr. 30,) other by minims 20 of dilute hydrochloric acid, before meals. Vitamin B has been tried without success. It is important that this form of vomiting should not be allowed to drift on unchecked, otherwise, owing to the consequent starvation, loss of fluid and ketosis, the patient's condition may become serious: once she has reached the stage at which there is almost continuous vomiting, rise of pulse-rate, loss of sleep, wasting and exhaustion, the treatment becomes correspondingly more difficult, and more energetic measures are required.

An essential part of the treatment, if the vomiting is severe, is to remove the patient from her home. Discipline and separation from the interference of too sympathetic friends and relations are important factors in the treatment. In most cases it is very striking how rapidly the vomiting ceases when the patient is removed to a hospital or nursing home. She cannot be expected to recover so long as she is surrounded by over-anxious relatives, or a fussy nurse who is continually offering her a basin, and keeps the bedclothes covered with waterproof sheeting. These are direct incentives to vomit; it is obvious to her that she is expected to do so, and the suggestive influence of these surroundings tends to a continuance of the vomiting. The patient must not only be put in proper surroundings, but she must also be helped by the mental atmosphere. She must be made to understand that the condition will soon pass, and she will be cured with certainty. It is better not to give her a fluid diet but to put her on to solids from the commencement of the treatment. The amount should be small in quantity and given at frequent intervals, for the feeling of nausea may return if the patient is allowed to become faint for want of food. She will, as likely as not, at first refuse to take solid food, but she should be assured that she can do so, and of the better results that follow. She ought, therefore, to be encouraged to eat, and the attendant may have to stay with her until she has done so. As a general rule these methods of treatment give immediate and striking results, for the patient, having found she can retain her food, is so impressed and encouraged that very little further persuasion is necessary and the further progress of the case is towards rapid and complete recovery. Drugs are not of great use in the treatment. Phenobarbitone may be used to allay anxiety and a sedative may be given at night; morphine is better avoided as it may cause vomiting by central stimulation. Antihistamine drugs such as largactil avomine, dramamine or anthisan may be tried. By this means sufficient fluid and carbohydrate for the normal metabolism of fat are restored to the patient. Since the accumulation of incompletely oxidized metabolites of fat in the blood may be a stimulus to the continuation of vomiting a vicious circle is stopped. If, however, the condition is of longer standing and does not yield readily to treatment along these lines, it may be necessary to adopt certain additional measures. Treatment by the carbohydrate replacement method should be adopted. All food by the mouth is stopped for 24 hours and the patient is given a rectal injection containing 10 per cent. glucose by the continuous drip method. A special point must be made to impress upon the patient that by this means she and the foetus can receive sufficient nourishment, and a hint dropped to the effect that as food is not being taken by

mouth, vomiting, in consequence, is an impossibility. The drip is given slowly, 2 to 3 litres (4 to 6 pints) in 24 hours being given. Sedatives, such as 30 grains of chloral in the rectal drip, should be administered at the same time. A subcutaneous injection of 10 mg. of vitamin B₁ should be given daily. After 24 hours during which all food by mouth is withheld and the vomiting ceases the patient is allowed small sips of lemonade and glucose. Soon she is able to nibble carbohydrate foods such as biscuits, bread and toast. Gradually the food and fluid by mouth is increased and the rectal fluid reduced. Replacement of fluids and carbohydrate is followed by a rapid return to normal by the patient. She stops being sick and regains her weight, acetone disappears from the breath and urine, the tongue becomes moist, the pulse-rate falls and the blood-pressure rises.

In rare cases vomiting continues in spite of the above therapy and the patient's condition deteriorates. The position may now become very serious indeed. Should rectal therapy not prove successful, then intravenous glucose 6 per cent. and $\frac{1}{2}$ per cent. saline must be started at once before it is too late. Four to six pints of intravenous glucose-saline solution are given in 24 hours. To it are added daily, 50 mg. vitamin B₁ (aneurin hydrochloride) or the equivalent dose of vitamin B complex, and 10 units of insulin for each pint of solution. The insulin is given to stimulate the metabolism of carbohydrate in the liver. Methionine, a lipotropic amino-acid, has been shown to have a protective action on the liver in cases of experimental poisoning. It can be added to the drip in doses of 10 to 20 g. daily. The daily intramuscular injection of 20 c.c. of 10 per cent. solution of calcium gluconate may be of value. When chlorides reappear in the urine (as shown by a white cloud when dilute silver nitrate solution is added) the glucose solution should be given in $\frac{1}{5}$ N-saline. In a few cases vomiting continues in spite of intravenous replacement therapy. In such cases pregnancy should be terminated as the only means of saving the life of the patient.

It is seldom necessary in practice to resort to any of the more energetic measures. Many patients do not even require rectal injections. The essentials to success are a change in the patient's surroundings, the attitude of the nurse and doctor, and an atmosphere of certainty and confidence that she will recover and that the symptoms will not recur.

Termination of Pregnancy.—It should be remembered that this measure is but rarely required, and should be adopted only after all other methods have failed, although they have been thoroughly and efficiently carried out. The difficulty in these cases is to decide when

to induce abortion. Firstly, no account should be taken of the wishes of the patient or her relatives. Secondly, unless the woman is obviously very ill, the decision to terminate the pregnancy must never be made until a serious attempt at correct treatment has proved to be a failure; nor must the decision be influenced in any way by reports from the patient or her relatives as to the frequency or severity of the sickness. Women, whose appearance in no way suggests starvation, will aver that for some weeks not a morsel of food has passed their lips but that it has been completely and promptly vomited. Such patients will look well and may even have a daily action of the bowels; the pulse-rate and blood-pressure will be normal and the urine will not contain any ketone bodies. The persistence of vomiting in spite of proper treatment, the appearance of symptoms and signs such as a progressive emaciation, slight jaundice, a rising pulse-rate or temperature, a falling blood-pressure, or a scanty secretion of urine which contains albumin in addition to ketone bodies, are indications that it would be unwise to allow the pregnancy to continue. If pregnancy is terminated too early it will frequently be done unnecessarily, but it should never be delayed if the patient becomes very ill; for the operation, instead of doing good, may be sufficient to turn the scales against her.

The two developments which make immediate termination of pregnancy imperative are liver failure and nervous complications. Unfortunately, by the time either of them can be diagnosed, treatment, even by termination of pregnancy, will probably be too late and the patient will die. In spite of such complicating factors being present, a life can occasionally be saved by termination in addition to intravenous glucose-saline infusion, vitamin B, calcium gluconate and methionine therapy. But it should be the aim only to carry out the operation on the understanding that it is being done to prevent these complications from developing.

The indications, which usually occur in combination, for the termination of pregnancy can be summarized as follows:—

1. A steady deterioration in spite of treatment.
2. A steadily rising pulse-rate of 100 per minute or over.
3. An increasing pyrexia.
4. A steadily falling blood-pressure below 100 mm. Hg.
5. A gradually increasing oliguria and the appearance of albumin in the urine.
6. Jaundice.
7. Central nervous complications.

Either of the two last named signs (6 and 7) is a definite indication for the immediate termination of pregnancy. Their

appearance, however, usually means a fatal outcome; treatment is seldom of avail.

Before abortion is induced the obstetrician is advised always to obtain the concurring opinion of a specialist colleague to free himself of any undue legal responsibility. Induction of abortion is better done with the aid of an anæsthetic other than chloroform on account of the fact that chloroform may itself damage the liver. Up to the end of the 12th week the uterus can be most easily emptied *per vaginam* by cervical dilatation and the use of ovum forceps. After the 12th week it is too dangerous to empty the uterus by this means because perforation of the uterus may occur, and because of the difficulty in delivering the foetal head an extensive split of the cervix at the internal os is almost inevitable. For these reasons the operation of abdominal hysterotomy has to be undertaken, and, in those cases in which it is correctly used, will be life-saving.

JAUNDICE AND VOMITING DURING PREGNANCY

Acute Yellow Atrophy and Obstetric Yellow Atrophy of the Liver

Hyperemesis Gravidarum and Liver Failure.—Vomiting and jaundice are found in several unrelated conditions which may be confused in pregnancy. Liver failure may be the end result of severe hyperemesis gravidarum. The disease begins early in pregnancy and in the rare event of death it always occurs in the first two trimesters. Jaundice is the sequel of a prolonged spell of severe vomiting. The final confirmation of the diagnosis is made post-mortem when the small yellow liver is examined histologically. There is no necrosis of liver cells but a centrilobular fatty infiltration. The fat is arranged in large vacuoles.

Acute Yellow Atrophy, Infective Hepatitis and Homologous Serum Jaundice.—Acute yellow atrophy of the liver and obstetric yellow atrophy are two extremely serious diseases which may complicate pregnancy. The very rare disease of idiopathic acute yellow atrophy in the absence of a demonstrable poison occurs no more frequently in pregnancy than it does in the general population. The patient dies rapidly from liver failure and post-mortem examination reveals that the liver is small and yellow and that there is a gross degree of acute massive necrosis of the whole of the liver lobules. It is almost certainly a severe form of infective hepatitis. This is a febrile condition with a well recognized course, and when it occurs in an epidemic is easily diagnosed. The jaundice is marked and vomiting not usually severe.

The liver is generally palpably enlarged. The patient does not, as a rule, become gravely ill. The hepatic lesion is one of centrilobular necrosis. Very seldom complete liver failure, shown by deepening jaundice, severe vomiting, epigastric pain, headache, restlessness, delirium and convulsions, followed by increasing coma and death, occurs. The pathological picture is then that of acute yellow atrophy. Infective hepatitis may occur as the result of the infection of the virus in a blood or plasma transfusion or during the use of a contaminated syringe. It is then referred to as homologous serum jaundice.

Obstetric Yellow Atrophy.—Another rare phenomenon is a condition in which, during the last 4 weeks of pregnancy, the patient is suddenly seized with epigastric pain and vomiting, followed in a few days by jaundice. The symptoms progress rapidly, she is delivered of a still-born child, becomes comatose and dies. Thus, clinically, the picture is very like acute yellow atrophy. But examination of the liver shows no necrosis. Instead, there is a fatty infiltration of the cells of the entire liver lobule with a foam of tiny fatty vacuoles. On pathological grounds, therefore, the condition is distinct both from hyperemesis gravidarum and from acute yellow atrophy. For this reason it has been suggested that the term *Obstetric Yellow Atrophy* should be used to indicate the disease. It is sometimes referred to as *Icterus Gravis Gravidarum*. Its ætiology is quite unknown. Liver necrosis has been produced experimentally in animals by depriving them of the amino-acids cystine and methionine. It is not clear what connexion this has with human disease.

Delayed Chloroform Poisoning.—Delayed chloroform poisoning may cause death from liver failure a few days after chloroform has been administered. Necrosis of liver cells is always found post-mortem and it varies in its lobular distribution according to the circumstances in which the chloroform was given. An overdose of chloroform in a healthy patient gives rise to an isolated cell necrosis; chloroform given to an exhausted patient, *e.g.* after a prolonged labour, is followed by mid-zone necrosis; chloroform given to a patient suffering from hyperemesis gravidarum produces central necrosis.

Other Cause of Jaundice.—The causes of jaundice in non-pregnant women may occur in pregnancy and give rise to difficulty in diagnosis. An example is cholelithiasis.

Treatment.—The treatment of obstetric yellow atrophy (icterus gravis gravidarum) and true acute yellow atrophy is the same. The

only hope of saving the life of the patient lies in the immediate emptying of the uterus. Abdominal hysterotomy usually has to be done. At the same time steps are taken urgently to treat the liver deficiency. Six per cent. glucose in $\frac{1}{2}$ per cent. sodium chloride is given intravenously with insulin, ten units per pint, vitamin B and methionine. Calcium gluconate is given intramuscularly. Four to six pints of glucose-saline are given in the 24 hours until the vomiting has ceased and consciousness is regained, when the patient is able to take fluid and food by the mouth.

CHAPTER XX

DISPLACEMENTS OF THE PREGNANT UTERUS

RETROFLEXION AND RETROVERSION

It was thought that pregnancy occurs less readily in the retro-displaced uterus, especially if of the congenital type. If this is true it probably depends upon other associated errors of development rather than the mere position of the organ. "

In the acquired variety of retroversion the tendency to sterility is even less marked, and if abortion occurs it would seem rather to be a result of the accompanying changes in the uterus, such as characterize subinvolution, than of the position of the uterus itself. However this may be, pregnancy occurs in the retroverted uterus of both the congenital and acquired varieties, and the pregnancy usually goes to term without complication. The fundus uteri rises spontaneously from the pelvic cavity into the abdomen as pregnancy proceeds.

Pregnancy in a backwardly displaced uterus continues, as a rule, up to the end of the 12th week without giving rise to any symptoms which attract attention, so that it remains undiscovered unless a bimanual examination has been made.

Between the 12th and 16th weeks, in the great majority of cases, the displacement is gradually corrected by the growth of the uterus and by the fundus rising out of the pelvic cavity. In a small minority of cases, often in association with a flat pelvis with a projecting promontory, this correction does not occur, and the developing uterus gradually fills the pelvic cavity completely and there becomes impacted. Retention of urine and abortion may occur owing to the inability of the uterus to rise into the abdomen.

This condition is known as incarceration, and is of importance because of the grave results which may be produced in the urinary system if it is not relieved. At first pain occurs in the lower abdomen and back; as the intrapelvic pressure increases, the bladder is pushed up into the abdomen and the urethra elongated. With elongation of the urethra retention of urine usually results. This retention has been ascribed to pressure on the urethra, but this is not the case, as a soft catheter can easily be passed. It may be due to some interference with the neuro-muscular mechanism of micturition and the elongation and curving of the urethra (Fig. 80).

When the overdistension has become sufficiently great, incontinence

of urine will follow, the bladder voiding a little urine at frequent intervals, but never being able to empty itself completely. This condition is generally known as retention of urine with overflow, or the incontinence of retention. If the bladder is not relieved, cystitis

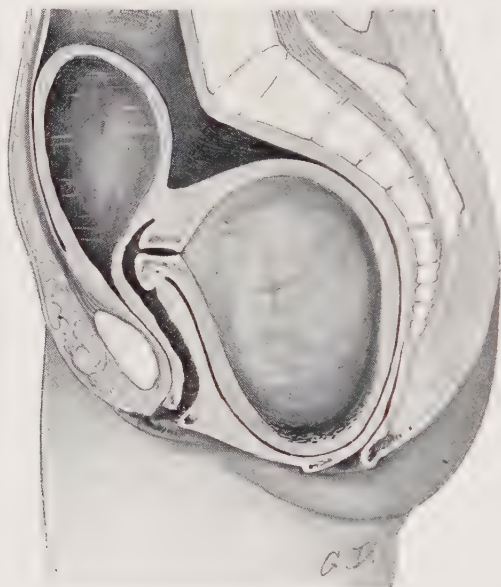


FIG. 80.—INCARCERATED RETROVERTED GRAVID UTERUS, SHOWING RETENTION OF URINE.

The body of the uterus is incarcerated below the promontory of the sacrum. The cervix is displaced upwards, lengthening the urethra.

develops, the walls of the bladder become œdematous and thick, gangrene of the mucous membrane may ensue, and this membrane may be passed *per urethram*.

DIAGNOSIS

Any disturbance of the bladder function between the 12th and 16th weeks of pregnancy should direct attention to the possibility of a retro-displaced uterus. Obstruction to the passage of urine may be sudden and absolute, or there may be a complaint of frequent micturition with slight incontinence. Pain may be entirely absent.

Abdominally, the distended bladder will be detected as a tense fluctuating tumour, which disappears when a catheter is passed and the bladder emptied. It should be remembered that the degree of distension may be great; the bladder may contain as much as 5 or more pints (2·5 litres) of urine which may have to be drawn off.

On attempting to introduce the finger into the vagina unusual difficulty is experienced, since the posterior vaginal wall is pushed forward by a smooth elastic swelling which occupies the hollow of the sacrum. This is made out to be the uterus, and on seeking the cervix it is found to be high up behind the symphysis pubis, or in some patients cannot be reached by the examining finger.

The condition most likely to be confused with a retroverted gravid uterus is a pelvic hæmatocele. The history may give valuable assistance, but the diagnosis can be cleared up only by making out that in the latter condition the slightly enlarged uterus lies in front of a soft mass with the cervix pointing downwards. Whereas in the case of a retroverted gravid uterus, the uterus itself is enlarged and retroverted, so that the cervix is high up and above the symphysis pubis; if the cervix can be reached it will be found to be pointing forwards. Another uncommon condition which gives rise to similar symptoms is a fibroid in the posterior wall of the uterus, and if the fibroid is associated with pregnancy the differential diagnosis will often be attended with very real difficulty. A single interstitial fibroid causes a symmetrical enlargement of the uterus, and during pregnancy the fibroid frequently becomes soft. As the treatment early in pregnancy is expectant, like that of a retroverted gravid uterus, the differential diagnosis is not of great practical importance.

TREATMENT

Treatment before Retention has Occurred.—If a patient is found to have an 8 or 10 weeks' pregnancy in a retroverted uterus there is no need to interfere as the uterus will probably replace itself if left alone. The patient should be kept under observation. Coitus should be forbidden. The growth of the uterus usually corrects the displacement between the 3rd and 4th months of pregnancy, and once the uterus is 16 weeks pregnant it is too big again to become retroverted. Patients treated in this way are less likely to abort than those in whom the early pregnant uterus is replaced manually.

If a patient has had symptoms of incarceration in a previous pregnancy, it might be considered necessary to replace the uterus and insert a pessary. However, it is preferable and equally helpful if a pessary be inserted without replacing the uterus. The pessary exerts a constant pressure on the fundus uteri through the posterior fornix of the vagina and so assists in its ascent. If replacement is performed, the patient should be given morphia and kept in bed for 24 hours to lessen the risk of abortion. The pessary should be removed after the uterus has undergone spontaneous anteversion.

Treatment when Retention has Occurred.—The organ that requires treatment is the bladder, not the uterus; the displacement of the uterus being of importance simply because it upsets the function of the bladder. If retention is not relieved there is danger of cystitis. The bladder should be emptied by a catheter every 4 hours, or better still the catheter is allowed to drain continuously for 24 hours, the patient being kept in bed mainly in the semi-prone position. This will usually be sufficient and spontaneous anteversion will follow usually within a few days. In 4 or 5 days an attempt should be made to replace

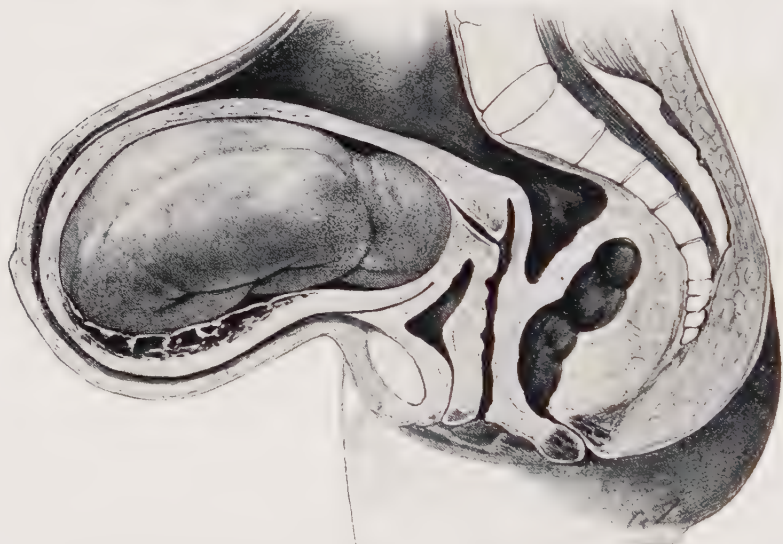


FIG. 81.—ANTEVERSION OF PREGNANT UTERUS, "PENDULOUS BELLY".

the uterus. It may be necessary to administer an anæsthetic. Occasionally catheterization may be necessary for a few days after the uterus has been replaced since the patient is not able to empty her bladder completely. If these measures do not succeed in the replacement of the uterus the patient should be kept in bed, and the bladder emptied at regular intervals when, in the majority of cases, the uterus spontaneously assumes its correct position. There is never any need to decompress the bladder slowly in these cases for the risk of hæmorrhage from the kidneys does not exist.

ANTEVERSION OF THE PREGNANT UTERUS

In multiparæ during the later months, owing to atony of the abdominal muscles, or in primigravidæ owing to pelvic contraction or spinal deformity, the fundus uteri may fall right forward, and the

abdomen become unusually prominent. This condition is known as pendulous belly and is responsible for the production of malpresentations.

The treatment in pregnancy is to fit a suitable belt or corset; during labour a firm abdominal binder should be adjusted, and labour should be conducted with the patient on her back until the presenting part has entered the pelvic cavity. This will correct the faulty axis of the uterus and enable the contractions to act in the right direction. The loss of the auxiliary abdominal muscles is felt in the second stage and delivery by the forceps may be required,

SACCULATION OF THE PREGNANT UTERUS

The very rare condition of sacculation of the uterus may occur from the disproportionate expansion of either the anterior or the posterior uterine walls.

Obstructed labour has resulted from the operation of ventral fixation, practised so constantly years ago for the relief of symptoms, real or imaginary, which were ascribed to a retroverted uterus. This complication may occur in two ways. The anterior surface of the uterus having been fixed near the fundus it will be firmly held at this point, and symmetrical enlargement will result in the uterus lying almost horizontally at term; the cervix pointing backwards at an abnormally high level. In other cases the anterior wall is increased in thickness but does not expand, so that the foetus develops in a sacculation of the posterior wall.

PROLAPSE

Pregnancy in a partially prolapsed uterus is not at all unusual. In such cases, as the pregnancy advances, the uterus, as a rule, rises up in the pelvis until it has passed the inlet, and then prolapse is no longer possible.

The minor degrees of prolapse only require treatment until the uterus has risen above the inlet, and a suitable ring pessary is usually sufficient. Vaginal wall prolapse commonly becomes more marked during pregnancy and may be treated by a ring pessary. Pregnancy in a completely prolapsed uterus is very rare. As a rule the cervix becomes retracted when labour begins, though on rare occasions it remains protruding through the vulva, becomes swollen, and so gives rise to obstruction. Sepsis should be treated by disinfection with a non-irritating antiseptic, but the most important point is that the patient should be kept in bed for some days before labour, with the cervix within the vagina to allow the œdematous swelling to subside.

The increased danger of puerperal sepsis in these cases is an additional reason for keeping such patients in bed in order to keep the exposed parts free from fresh contamination after they have been cleansed with an antiseptic, and the foot of the bed should be raised.

It is usual to delay operation for prolapse until the patient has completed her family. If however, she becomes pregnant again after a repair has been carried out, normal labour should be allowed to take place with an episiotomy and low forceps delivery to protect the reconstituted supports of the uterus and vagina. If the cervix has been amputated it usually dilates more quickly than usual but occasionally dystocia develops and either the cervix tears or fails to dilate. In such a case Cæsarean section is carried out at once. Some obstetricians advise Cæsarean section after all operations for prolapse.

HERNIA AND PREGNANCY

As a general rule herniæ are not made worse by, and do not affect the course of, pregnancy. Symptoms from inguinal and femoral herniæ are usually improved, as the growing uterus pushes the bowel away from the orifices and eventually blocks access to them. Rarely these types of herniæ may first appear during pregnancy.

In the case of umbilical hernia, if intestine is adherent to the sac, it may become dragged upon by the growing uterus and intestinal obstruction may occasionally follow.

Diaphragmatic hernia is a rare but occasional complication of child-bearing in women in whom there exists a congenital deficiency in the diaphragm. Through this the upwardly displaced bowel and stomach may be forced into the thorax. Much more common is the condition known as hiatus hernia. Such patients complain of vomiting throughout the pregnancy, perhaps increasing as term approaches. They also have severe heartburn and may find relief by sleeping propped up with pillows, because lying down, particularly after a meal, makes the symptoms worse. All symptoms of hiatus hernia usually disappear after delivery.

ABNORMALITIES OF THE GENITAL TRACT

There are many kinds of uterine abnormality which do not necessarily prevent pregnancy occurring.

A woman with a double uterus and cervix may become pregnant in one or both horns and labour is often normal. If pregnancy occurs in only one uterus it is possible for the other one, which undergoes both myometrial and decidual hypertrophy, to obstruct the entrance of the

foetal presenting part into the brim of the pelvis and Cæsarean section may be necessary. The smaller uterus is sometimes mistaken for a fibroid.

A bicornute or arcuate uterus may cause a malpresentation at term, sometimes a shoulder presentation. Such developmental abnormalities, including septate uterus, may also cause repeated abortion.

A septate vagina may be present with or without a double uterus and cervix. Often there is no obstruction to delivery although the septum may have to be excised.

The more gross manifestations of uterine abnormality are often accompanied by hypoplasia and infertility so that complications of pregnancy do not occur. “

CHAPTER XXI

ABORTION

THE earliest date at which the child is considered viable is the 28th week ; the expulsion of the child before the 28th week is known as abortion or miscarriage, whereas after that date it is spoken of as premature labour. The use of the term abortion for all cases up to the 28th week is convenient and corresponds with the nomenclature of the Registrar-General. As applied by the medical and nursing professions the terms 'abortion' and 'miscarriage' are synonymous, although the laity is apt to associate the former with illegal procedures. There is no sharp line of distinction between a late abortion and an early premature labour—the division is merely one of convenience. Similarly, it will be found that many cases of abortion pass gradually into the cases which are discussed under the title of Antepartum Hæmorrhage. In both, bleeding before delivery is a cardinal symptom, the causation is often similar and the surgical principles guiding the treatment identical. In Britain, delivery of the fœtus before the 28th week of intra-uterine life is not notifiable but all deliveries after this date must be notified.

Frequency.—It is impossible to give an accurate figure of the frequency of abortion because the pregnant state is not notifiable and only a small proportion of patients who are aborting seek medical advice. Again, many of the earlier cases are not definitely diagnosed, but are regarded by the patient as a delayed menstrual period or a flooding, and a doctor is not consulted. Also, frequently, a patient may conceal the fact that she has had an abortion. It has, however, been computed that 8-10 per cent. of pregnancies end in abortion. The proportion of abortions to full-time labours is higher in large cities than in rural districts. It is difficult to assess the frequency with which abortion is induced criminally, but the figure is high, particularly in the large cities, and it is this type of abortion which has the highest morbidity and mortality.

Period of Pregnancy.—The most common time for abortion to occur is from 8 to 11 weeks; doubtless many early cases are unrecognized, especially those occurring after only a short period of amenorrhœa.

CAUSES OF ABORTION

In 50 per cent. of cases a definite cause cannot be determined ; even when one is recognizable, its method of action is frequently obscure, so that any attempt at classification of the causes of abortion must be, to a certain extent, theoretical and arbitrary.

1. Maternal*(a) General Conditions*

Endocrine imbalance, such as progesterone deficiency, and hypothyroidism.

Chronic nephritis ; diabetes, syphilis, the acute specific fevers and plumbism. Hyperpyrexia of any origin.

Essential hypertension.

Functional causes in habitual abortion.

(b) Local Conditions

Pelvic abnormalities, such as retroversion, uterine fibroids, operations for ovarian cysts, and extensive lacerations of the cervix.

Decidual abnormalities.

Congenital abnormalities of the uterus.

2. Paternal

Abnormal spermatozoa.

3. Ovular

(a) Deficiency of the Germ Cells leading to early atrophy of the foetus or failure of development of the embryonic area.

(b) Aberrant and Abnormal Development.

Hydatidiform mole.

4. Traumatic*(a) Criminal Abortion*

Introduction of foreign bodies or irritating chemicals into the uterine cavity or vagina.

(b) Irritation of or Damage to the Uterus and Adnexa during operations such as myomectomy or oöphorectomy, or during the replacement of a retroverted gravid uterus.

(c) Reflex Stimulation of the Uterus by emotional disturbances.

(d) Coitus during the first 3 months of pregnancy.

The commonest cause of spontaneous abortion is an abnormality of development of the foetus or trophoblast which is severe enough to

cause death. This condition is in most cases a non-recurring factor, and the patient has an 80 to 90 per cent. chance of going to term on the next occasion. For this reason it is safe to reassure the patient who has miscarried for the first time that her next pregnancy will most likely be uneventful. The mother is always anxious for a reason why she has miscarried, and it is safe to tell her that the most likely cause of a single miscarriage is a developmental abnormality of the foetus. so that it is as well that it did not survive. Reassurance is then given that such abnormalities are most unlikely to recur in subsequent pregnancies. Needless to say, this advice should not be given when the patient is still suffering only from a threatened miscarriage.

Probably the second commonest cause of miscarriage is an abnormality either of hormonal balance or of development of the uterus. In the former case the ratio between pituitary and placental hormones and oestrin and progesterone secretion are abnormal. In the latter case the uterus, being deficient in development, becomes more and more irritable as the cavity is stretched by the growing foetus, so that it begins to contract and retract, thus discharging its contents.

Upon the adequate secretion of progesterone by the corpus luteum in the early weeks and its continued secretion by the placenta from the time of its full formation the successful continuation of pregnancy largely depends.

The action of progesterone is concerned mainly in the proper embedding of the growing ovum in a fully formed decidua ; but it is also said to be concerned in a desensitizing effect upon the uterine muscle to neutralize the latter's reaction to the oxytocic factor of the posterior pituitary. This desensitizing action may play a part in the later months of pregnancy in preventing the onset of premature labour, it may also play a part in the early months in the prevention of abortion. Where adequate laboratory facilities are available, the degree of progesterone activity may be assessed by estimating the amount of its excretory product, pregnandiol, in the urine. The amount of pregnandiol excreted rises until about the 34th week of a normal pregnancy ; it then decreases and finally disappears a few days after delivery. In cases of threatened abortion a 24 hour specimen of urine is investigated for pregnandiol content and if the amount is found to be lower than the normal it can be assumed that the attachment of the ovum to the decidua is precarious. Obviously such a finding may denote that it is too late to do anything to prevent the threatened abortion at this stage becoming inevitable and the low pregnandiol secretion may even denote an already dead ovum *in utero* which could lead to a carneous mole. This test therefore, which is time-consuming and not easy to carry out, is not really of much value when

undertaken in cases in which there is already a threat to abort. If the test is to be used rationally it could be of value when done repeatedly in cases of habitual abortion, before the bleeding begins. If the readings were low in these circumstances progesterone given in large doses might prevent the onset of a miscarriage.

There is little evidence that rhesus incompatibility is a cause of miscarriage in the first 3 months of pregnancy. As usual great care must be taken in cross-matching blood when it is to be given for resuscitation in cases of abortion. Giving rhesus positive blood to a rhesus negative mother will, of course, produce rhesus antibodies which in the future may lead to the death of the first baby born if the husband is rhesus positive and the mother rhesus negative. Another important point is that an abortion which is uncomplicated and complete may rarely lead to the production of rhesus antibodies in a rhesus negative woman if her husband is rhesus positive. In this way also the first baby born may suffer from rhesus incompatibility and fail to survive without adequate treatment.

Thyroid deficiency may be a cause of miscarriage, but it is unjustifiable to administer thyroid extract unless clear evidence of deficiency is present.

Any general disease may cause abortion if it is sufficiently severe and this applies specially to acute illness in which the temperature is high and the toxæmia severe. Malnutrition and severe hypovitaminosis are other causes, but they are uncommon in the British Isles where the intake of vitamins is generally adequate. Although deficiency of vitamin E is a proven cause of abortion in experimental animals its administration to women who tend to abort is of doubtful value because of the quantity of vitamin present in the average diet.

The abortion rate is increased above the average in the diabetic mother whose disease is not adequately controlled. The association of chronic forms of nephritis with pregnancy is not very common and there is always a risk of abortion occurring although the foetus is in greater danger later on in the pregnancy when placental changes may cause anoxia and foetal death.

Syphilis is an uncommon cause of miscarriage in the early months of pregnancy, for the disease is more likely to cause death *in utero* after the 28th week of intra-uterine life due to the changes in the placenta and the developing disease in the foetus.

If lead is absorbed by a pregnant woman it may affect the ovum and result in abortion. For this reason pills containing lead are sometimes administered in a criminal attempt to produce abortion.

The woman who becomes pregnant when suffering from essential hypertension may miscarry although she is more likely to produce

a small premature baby with a tiny placenta and consequent anoxia in the foetus. A superimposed toxæmia of pregnancy is a common complication and increases the dangers to the foetus very greatly.

There is no doubt that an acute emotional shock may cause abortion. Some consider that a psychiatric factor may play some part in the recurrent and apparently spontaneous evacuation of the uterus in cases of habitual abortion.

Paternal and Ovular

Abnormal spermatozoa may theoretically be the cause of abnormal development of the foetus which is a common cause of a single spontaneous abortion, but this is difficult to prove.

It has long been recognized that some gametic combinations are infertile and either do not develop at all or die at an early stage; such an occurrence has been ascribed to incompatibility and it can occur in the human species. This presumption can only be accepted if there is evidence of the fertility of each individual with another partner.

Abnormal development of the ovum may result in a hydatidiform mole which always results in abortion except on rare occasions when only part of the placenta is affected and this may only be discovered when the baby is delivered at term.

A fibromyoma of the uterus may cause a miscarriage if it is submucous in situation. However, many women with small uterine fibroids which are not submucous succeed both in becoming pregnant and in having a normal labour. Retroversion of the uterus is often associated with early pregnancy, but the malposition itself is rarely the cause of abortion. If abortion should be threatened or become inevitable in a first pregnancy, then hypoplasia of the uterus is the more likely cause.

When an ovarian cyst is found in association with early pregnancy the cyst should be removed after the 16th week. The corpus luteum may be situated in the ovary which contains the cyst and removal before this date will greatly increase the risk of abortion as a result of the operation.

Extensive lacerations of the cervix which reach as far as the internal os may result in abortion at the 12th week or after. At this stage of pregnancy the membranes begin to impinge upon the internal os, for the foetus now fills the whole uterine cavity. If the membranes are not properly supported they may rupture and abortion will result.

Even without extensive laceration of the cervix, the internal os may be functionally inadequate. Rarely this is of congenital origin but more commonly it is due to a previous vigorous dilatation of the

cervix for dysmenorrhœa, to surgical evacuation of the uterus in incomplete abortion or even to precipitate labour on a previous occasion.

All attempts to procure abortion by whatever method and however early in the pregnancy are illegal, even if unsuccessful. Advice given to the woman as to whom to consult for the procuring of an abortion is illegal and the informer risks a charge of aiding and abetting.

Criminally-induced Abortion.—The methods adopted may be classified into three main groups—taking abortifacient drugs, indulgence in violent physical exercise, and the introduction of fluids, slippery elm bark, or instruments into the vagina or uterus. The common method of injecting soapy water, by means of a syringe into the cervical canal frequently leads to death from air embolism. The drugs used include quinine, ergot, pennyroyal and strong purges, usually taken in an attempt to irritate the uterus and cause it to expel the ovum; or lead salts which it is hoped will kill the ovum. Hence the association of symptoms of cinchonism or lead colic with an abortion should raise a very strong suspicion that the abortion has been induced.

The passage of slippery elm bark, crochet-needles, douche-nozzles by the patient, or catheters, sounds or blunt syringe-nozzles by the abortionist may cause serious lacerations of the vagina, cervix and uterus. The instrument is frequently not sterile and so the interior of the uterus is often infected; if a laceration is caused, it is also infected. The risks are increased if fluid is forced into the uterus or peritoneal cavity. Hence the presence of abrasions or lacerations in the genital tract with or without the early onset of signs of infection strongly suggests criminal abortion. Regarding physical exercise, many women indulge in strenuous gymnastics with or without hot or cold baths in the hope of inducing a hæmorrhage from the uterus. But it is an extremely uncertain method, as some women can go through serious accidents or undergo abdominal operations without symptoms of abortion, whereas others may abort after the slightest strain. Induced abortions often occur between the 8th and 12th weeks of pregnancy, because it is not till the second period is missed that the patient decides that she must be pregnant and then takes steps to have the pregnancy terminated.

The maternal mortality following criminal abortion is about 8 times greater than that associated with spontaneous abortion which is proof enough of the very great danger attendant upon criminal interference in these cases. Since the advent of sulphonamides and the antibiotics and especially since 1946 the total number of deaths from abortion in the British Isles have been reduced from 233 in 1945 to 72 in 1956.

The direct causes of death associated with abortion are as follows :

(a) *Sepsis*.—The pattern has changed in recent years for the *hæmolytic streptococcus* was lethal in the earlier part of the century but now the *staphylococcus aureus*, so often resistant to penicillin, is the most common causative organism and this is followed in order of frequency by the anærobic organisms.

Criminal interference is frequently the means of introducing a pathological organism from an extraneous source by means of an instrument directly into the chorio-decidual space causing an acute inflammation of the decidua and septicæmia may follow. At a later date salpingitis may develop and spreading peritonitis; or the latter may occur quickly and acutely due to perforation of the uterus or the pouch of Douglas by an instrument. Similarly an instrument may be passed obliquely into the uterus and thus perforate the muscle wall and enter the broad ligament where a parametric abscess may occur.

(b) *Hæmorrhage*.—A combination of sepsis and severe hæmorrhage is the most dangerous of all and replacement of blood loss is absolutely essential in the severely anæmic patient. The flying squad may have to be called upon to administer resuscitative measures in the patient's own home in cases in which collapse has occurred as a result of an incomplete abortion with torrential bleeding. The transfer of such a case by ambulance before the anæmia and shock have been treated may prove fatal.

(c) *Shock*.—A combination of tissue damage and hæmorrhage in criminal abortion is the commonest cause of shock in these cases. Occasionally a patient collapses and dies from profound shock when an instrument is passed through the internal os without an anæsthetic in a frightened woman who realizes she is taking a risk. The injection of soapy water into the uterus may also have the same effect.

(d) *Anuria*.—This complication of hæmorrhage and shock if it becomes irreversible will end in death from uræmia perhaps many days later.

CLINICAL VARIETIES

It is customary to make use of certain terms to describe the clinical varieties of abortion.

Classification

- | | |
|-------------------------|-----------------------|
| 1. Threatened abortion. | 5. Septic abortion. |
| 2. Inevitable abortion. | 6. Missed abortion. |
| 3. Complete abortion. | 7. Habitual abortion. |
| 4. Incomplete abortion. | |

(1) *Threatened Abortion*.—When the process of abortion begins but its progress is arrested before it has reached a phase from which recovery is impossible, the case is described as one of threatened abortion. The clinical condition is clearly the early stage of abortion, and is consequently associated with bleeding and occasionally some pain in the lower abdomen. The pain is usually dull in character and often felt low down in the back or in front. This sometimes reminds the patient of the pain which she has previously experienced with menstruation. Uterine contractions, even in threatened abortion, may cause rhythmical pains like those of early labour. A further stage is marked by commencing dilatation of the internal os. In parous women the external os is frequently permanently dilated, hence its condition is, in this connexion, of no diagnostic value. But thinning or taking up of the cervix is of importance as indicating that the abortion is inevitable.

The determination of the fact that the pregnancy cannot possibly proceed to term is, from the point of view of treatment, of the first importance. It is, however, not always easy to draw a definite border line. Abortion does not necessarily follow even after repeated attacks of quite sharp bleeding, and it is not very unusual to meet cases in which slight hæmorrhage has continued for some time, and yet a healthy child had been born at term. These cases should, on the other hand, always be regarded as serious, since at any time a profuse bleeding may take place which demands interference without regard to the condition of the pregnancy. Dilatation of the internal os, if it be of any marked degree, should be regarded as an indication that the abortion is becoming inevitable. An abortion may therefore be regarded as threatened if (a) the pain is slight; (b) the bleeding is slight; (c) on examination the external os is closed in a primigravida, or the ovum cannot be felt at the os in a multipara.

The symptoms of threatened abortion are therefore bleeding from the uterine cavity, with or without a dull backache suggestive of the onset of menstruation, or even mild rhythmical uterine contractions.

The type of bleeding in threatened abortion is of interest. The hæmorrhage comes from either the potential cavity in the decidua lining the uterus, which is present until the ovum fills the whole cavity at the 12th week, or more often from the attachment of the fœtal trophoblast to the decidua basalis or the decidua capsularis. In either case the hæmorrhage is at first bright in colour. If it continues to be bright red and increases in amount the prognosis is correspondingly less good. A single bright loss followed by the escape of old brown blood merely means that an initial hæmorrhage has occurred but none since. It is not uncommon in threatened abortion after the 12th

week for such a dark brown blood-loss to go on for 1 to 2 weeks. This can usually be taken to mean that the foetus is growing satisfactorily; as the foetus grows it squeezes out the remaining old blood from the uterine cavity.

The amount of blood-loss and pain which can occur without the abortion becoming inevitable is surprising. All cases should be treated as threatened unless there is very good evidence for saying they are inevitable.

It is wise to pass a speculum with great gentleness to make sure that the hæmorrhage is not caused by a mucous polypus or even a carcinoma of the cervix. It is well to remember that often enough potassium permanganate crystals are sold to the unwary as an abortifacient drug. The tablets are placed in the vagina and ulceration with bleeding follows. The foetus is not at risk as the decidual cavity and cervical canal are not involved but the patient attends hospital or calls in a doctor because the bleeding, which can be severe, suggests to her that an inevitable miscarriage is occurring. It is important to cause the patient as little discomfort as possible; a well-lubricated speculum should be passed upwards and depressed backwards until the cervix is exposed. It is common to have difficulty in finding the cervix because the speculum is passed into the anterior fornix.

(2) *Inevitable Abortion*.—A threatened abortion becomes inevitable when the bleeding increases greatly and uterine contractions become rhythmical and strong. The cervix then begins to dilate and products of conception may sometimes be felt protruding through the external os. Before the 12th week it is quite common for the foetus and trophoblast to be extruded intact when the abortion becomes complete. About the 12th week the membranes often rupture and the foetus is passed, leaving the placenta behind, and all the complications of an incomplete abortion may arise.

It is of vital importance, therefore, to encourage complete evacuation of the uterus and to conserve blood-loss as much as possible. As soon as it is certain that the abortion is inevitable the treatment for threatened abortion must be completely reversed. Everything that is passed *per vaginam* should be kept for examination; in this way it is often possible to establish that the abortion is complete. The passage of a decidual cast in a case of ectopic pregnancy may be mistaken for products of an intra-uterine conception.

(3) *Complete Abortion*.—A complete abortion is one in which all the products of conception have been expelled. On examination (a) pain is absent, and the bleeding small in amount; (b) the uterus is felt to be hard, inelastic and much smaller than the period of amenorrhœa up to the time of the abortion would suggest; (c) if

the material passed has been saved it will be found that the whole of the ovum is present ; (d) the cervix may be only slightly patulous.

(4) *Incomplete Abortion*.—Here it is usually the fœtus which has been expelled, leaving part or whole of the chorio-decidual membranes or placenta in the uterus. On examination (a) the amount of bleeding may be very severe and bright in the first few days, but less in amount and darker later on. It will contain shreds of chorion ; (b) the uterus will be soft and bulky ; (c) the cervical canal will be dilated.

This condition may create one of the worst emergencies that any doctor has to deal with. It is possible for a woman to bleed so severely within the space of a few hours that the hæmoglobin level drops to 20 or 30 per cent. and often accompanying this is a severe degree of shock.

(5) *Septic Abortion*.—The uterine cavity may become infected before an abortion begins. This is often the result of a criminal attempt to produce abortion by an instrument in the cervical canal. The patient has severe suprapubic pain and a raised temperature and pulse-rate. There may be no bleeding or uterine contractions and the cervical canal may remain closed. There is some rigidity of the abdominal wall spreading outwards and upwards from the pelvic brim. The uterus is exquisitely tender on bimanual examination. Unlike puerperal intra-uterine infections the organism in cases of septic abortion is often the staphylococcus and not the hæmolytic streptococcus. Other organisms may also be present, such as bacillus coli and streptococcus fæcalis. An anærobic streptococcal infection is not uncommon and gas-forming organisms may also be found. If the abortion is incomplete a piece of placenta may block the internal cervical os so that pus and blood collects above it which often causes a high swinging temperature which drops dramatically when the uterus is evacuated.

In other severe cases of septic abortion septicæmia may be established before the patient calls in a doctor or attends hospital.

(6) *Missed Abortion (Carneous mole)*.—A carneous mole is a dead ovum which has died in the early months of pregnancy. The destruction is brought about by a slight progressive hæmorrhage ; the exact cause of the bleeding is not known, but it takes place into the decidua and chorio-decidual space, and the blood is maternal in origin. If it is sufficiently sudden or extensive, abortion will take place, but if not, the effused blood eventually surrounds the ovum and the chorionic membrane and villi are more or less destroyed. The blood is as a rule unequally distributed and bulges the amnion forward in irregular projections. This extravasted blood cuts off the developing ovum from its supplies, and it perishes.

The amnion, a resistant membrane, is usually found intact in the midst of the blood-clot. On rare occasions hæmorrhage takes place into its cavity.

There is often a marked disproportion between the state of the development of the foetus and the size of the amniotic cavity, and it has been suggested that this is due to an excessive amount of liquor amnii.

The destroyed ovum may be retained for many weeks in the uterus, during which time the fluid constituents of the blood surrounding the ovum will be absorbed and the wall will become fleshy,

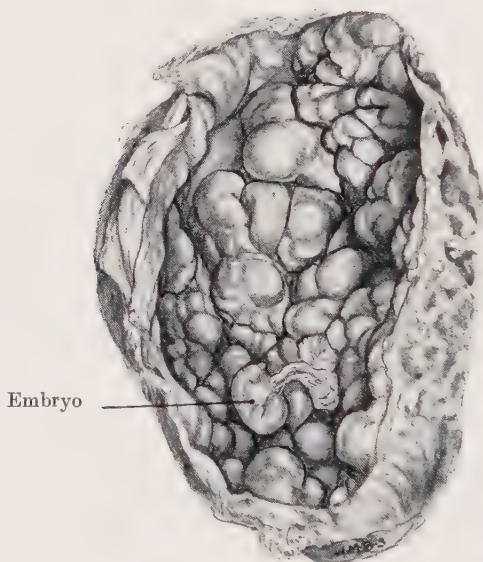


FIG. 82.—CARNEOUS MOLE.

hence the term “fleshy mole” is applied to this condition. The wall on section shows at times a laminated appearance, and microscopic examination of a portion shows degenerated chorionic villi in the blood-clot.

The formation of a carneous mole is uncommon. In these cases the patient usually notices a little blood-stained discharge for a day or two about the 8th to the 12th week of pregnancy. After this the breasts cease to be tender and swollen, but the patient often pays no attention to this. It is necessary in all cases of pregnancy to examine the abdomen at the 16th or 20th week in case the uterus has ceased to increase in size after the 12th week. A carneous mole can remain in the uterus for many months, and if it is not diagnosed the mother may

have everything ready for the baby, only to be told late in pregnancy that the foetus died in the first few weeks. In cases of missed abortion the breasts show no signs of recent activity and the uterus ceases to grow from the date of the small hæmorrhage. A pelvic examination reveals a firm uterus usually smaller than that of a three-months pregnancy. The uterus is filled with laminated blood clot with a shrunken amniotic sac in the centre. The biological pregnancy tests usually become negative about 10 days after the death of the ovum in these cases, and a pregnancy test should be carried out to confirm the diagnosis if this is made shortly after the vaginal hæmorrhage. Rarely in such cases the woman believes herself to have a live foetus and develops the symptoms and signs of pseudocyesis.

(7) *Habitual Abortion*.—By definition this refers to any case in which three consecutive spontaneous miscarriages have occurred. It can be shown statistically that a woman who miscarries for the first time has about an 87 per cent. chance of going to term the next time she is pregnant. A woman who has had two consecutive miscarriages still has a 63 per cent. chance in the next pregnancy, but after three consecutive abortions the chances of reaching full time on the fourth occasion drop to 16 per cent.

MORBID ANATOMY

In the first two months of pregnancy, the attachment of the ovum to the decidua is so delicate that separation may follow uterine contractions produced by any cause; or the immediate cause of abortion in the early weeks may be found in a hæmorrhage into the chorio-decidual space. The exact cause of that hæmorrhage is not known, but its result is to determine a degeneration in the affected tissues, and especially in the decidua basalis, so that the ovum becomes loosened and consequently acts as a foreign body and is expelled.

An examination of the structures cast off shows that in the majority of cases the decidua basalis remains in the uterus and the ovum with a part or the whole of the decidua capsularis is expelled. Occasionally the entire ovum and the entire decidual lining are ejected, or only the decidua capsularis may be torn through, and the ovum, surrounded by chorionic villi, is discovered among the material expelled by the uterus (Fig. 83). The chorion also may be torn through and the foetus expelled enclosed in its amnion and the liquor amnii; or the amnion also may be ruptured, and then the foetus escapes uncovered.

When the placenta is a definite structure, the foetus is usually expelled first. It is followed by the placenta and membranes,

but it is not unusual for the small placenta to be retained. Such retention may be associated with continued hæmorrhage. Septic infection of the retained products may ensue.

An abortion is in reality only a miniature labour, and in a typical case a process is gone through which closely resembles that of labour at term. The uterus undergoes rhythmical contractions, the cervix

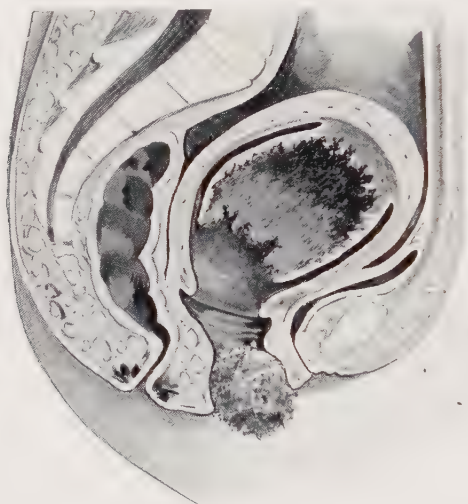


FIG. 83.—RUPTURE OF THE DECIDUA CAPSULARIS WITH ESCAPE OF THE OVUM SURROUNDED BY ITS CHORIONIC VILLI THROUGH THE RENT. ALMOST THE WHOLE DECIDUA IS LEFT BEHIND.

dilates, and when the internal os is sufficiently open the ovum is expelled entire or in part by the uterine contractions. If the ovum is entirely expelled the pain ceases and the hæmorrhage abates. For several days a blood-stained discharge continues to escape, but eventually ceases and the uterus involutes as after a normal labour.

SYMPTOMS

The two main symptoms accompanying abortion are hæmorrhage and pain.

Hæmorrhage is nearly always the first symptom, and is produced by separation of the ovum from the uterine wall. It is generally slight at first, but later varies considerably in amount, and all degrees of severity up to a fatal loss are met with.

Pain is usually of an intermittent nature, and is produced by the uterine contractions, and dilatation of the cervix. It is felt in the back and lower abdomen; but pain may be entirely absent, and in

any case it is not nearly so intense as that experienced during labour at term.

DIFFERENTIAL DIAGNOSIS

An ectopic gestation may frequently be confused with an early abortion. This is a serious mistake, and a correct diagnosis is essential, since the former is a dangerous condition, and confusion may lead to disastrous results. Both are usually associated with a short period of amenorrhœa followed by uterine hæmorrhage which is irregular both as regards time and character. But the hæmorrhage is, typically, of quite a different nature in the two conditions. In abortion it is usually bright red often accompanied by clots, and is much more profuse than in ectopic gestation. In the latter condition the bleeding tends to be slight in amount and may be red or dark brown in colour; it is due to the casting off of the decidua. The occurrence of vaginal hæmorrhage in an ectopic gestation is usually preceded by severe abdominal pain. The pain recurs in attacks at intervals. In abortion the pain is usually not nearly so severe and occurs after the onset of the bleeding; if present it is of the nature of miniature labour pains, but it is often absent.

The commonest fate of an ectopic pregnancy is the abortion of a tubal mole into the abdominal cavity and the formation of a pelvic hæmatocele. Consequently a definite mass appears in the pouch of Douglas postero-laterally to the uterus. This may be confused with a retroverted gravid uterus, but the position and direction of the cervix and the character of the swelling will afford the evidence necessary to distinguish the conditions. If, however, the ectopic pregnancy should rupture, the onset of symptoms is very similar to that observed in other acute abdominal conditions. A pelvic swelling cannot at first be detected, but a fullness may be felt in the pouch of Douglas. If the amount of internal hæmorrhage is sufficiently great, movable percussion-dullness may be made out in the abdomen and the general signs of loss of blood, *e.g.* pallor, restlessness, air hunger and a rapid pulse, will be observed. It should, however, be urged that, unless it is unavoidable, it is very unwise to wait for the general signs of internal hæmorrhage before arriving at a diagnosis.

Other conditions which are associated with irregular uterine hæmorrhage, *e.g.* intra-uterine polypus, carcinoma, and metropathia hæmorrhagica are at times confused with abortion. A careful history and vaginal examination will, as a rule, make the diagnosis clear. It must not be forgotten that bleeding during pregnancy may be due to carcinoma of the cervix.

TREATMENT

General Treatment.—When considering the causes of abortion it was stated that in some cases a definite cause could not be assigned so that the prophylactic treatment must be based on general principles. In dealing with these unexplained cases, there is no doubt that the irritability of the uterus and its response to external stimuli vary considerably in apparently healthy individuals. Women who show this tendency to abort should not run any risks, coitus should be forbidden during early pregnancy and over-exertion avoided. The patient should be instructed to rest in bed on the days when menstruation would have been expected, and to avoid purgative medicines. If on the other hand, a cause can be detected, it should be treated before conception has taken place. In the majority of cases it is unnecessary and unwise to replace a retroverted gravid uterus or to insert a pessary during the early weeks of pregnancy. If a patient has already miscarried once and the uterus is retroverted, it may be permissible to antevert the uterus and fit a Hodge pessary before the patient becomes pregnant again. The pessary is then removed after the 14th week has passed.

When abortion seems to be impending as evidenced by hæmorrhage and possibly pain, the first point to be settled is whether one is dealing with a threatened or an inevitable abortion. This can never be assessed with accuracy unless a vaginal examination is performed, which must be done with great gentleness to avoid stimulating contractions of the uterus.

A partially open cervix, severe bleeding, and palpation of part of the ovum protruding through the cervical canal are all indications of inevitable abortion. If the physical signs suggest that the abortion is still only threatened, the treatment described as suitable for this condition should be adopted. If, on the other hand, it is clear that nothing can save the pregnancy it should be treated as an inevitable abortion.

If there is an indefinite story of frequent attacks of bleeding of some severity with the passage of clots, and it is not clear what has been passed *per vaginam*, a diagnosis must be made from the general condition of the patient and the information obtained from a pelvic examination. If the size of the uterus corresponds with the duration of amenorrhœa and the loss of blood has not produced any marked symptoms, the case can be treated as a threatened abortion, and such patients may go to term in spite of several profuse bleedings. If, on the other hand, the os is dilated and it is clear that some portion of the ovum has escaped, or some portion of it is felt still protruding through the cervix, the uterus should be emptied without delay.

Again, if the uterus is still distinctly soft and larger than normal, though not large enough to correspond with the date of the pregnancy, and free hæmorrhage persists, even though the os be not widely dilated, it is safe to assume that some of the products of conception have been retained, and they should be removed forthwith. On rare occasions the uterus is much larger than the period of amenorrhœa would suggest and if hæmorrhage occurs and dilatation of the cervix begins, the presence of a vesicular mole should be suspected (page 247).

As soon as there is convincing evidence that the fœtus is dead the uterus should be emptied, as delay may expose the patient to the risks of hæmorrhage or sepsis.

Treatment of Threatened Abortion.—Here the guiding principle is to arrest the process, and to that end the patient should be kept at rest in bed for 5 days after the bright red hæmorrhage has ceased. She should have a normal diet. The loss of dark blood is not a reason for keeping her in bed. There are few households now where a patient can be given a bed-pan on these occasions, and it will do her little harm if she is encouraged to use a commode or to go to the lavatory when necessary. Otherwise she should stay strictly in bed. It is important to give the patient paraffin or any mild aperient which suits her so that she does not have to strain at stool. The administration of sedatives is important. An initial dose of morphine, 11 mg. (gr. $\frac{1}{6}$), is advisable if the patient is much upset, and then phenobarbitone, 65 mg. (gr. 1) or less, three times a day, should be given for the next few days. Opinions differ so much on the vexed question of hormone deficiency in these cases that it is difficult to be dogmatic on this subject. The chances of a spontaneous recovery are high, and it is doubtful whether the administration of progesterone will be of any value, but the injection of 20 mg. on alternate days for five doses can do no harm. The use of anterior pituitary and chorionic gonadotrophic hormones is valueless.

When the patient has recovered she should be warned to take great care at the next two period times and to avoid coitus for the next 3 months.

Treatment of Inevitable Abortion.—This may be summed up as the treatment of labour on a small scale. Generally, help is not necessary, the uterus expelling its contents unaided and involuting in the usual way. All that is required then is a rational technique bearing in mind the risk of infection. Care must be taken that anything passed is saved for examination. Treatment consists in complete rest in bed, which of itself lessens the amount of bleeding. An intramuscular injection of ergometrine, 0.5 mg., should be given

four-hourly for three doses, and may be repeated in the next 12 hours. The use of oxytocin, 5 units (0.5 ml.), may be substituted for ergometrine, but the latter has a more prolonged effect on the uterine muscle. Whole posterior pituitary extract, or vasopressin, should never be used.

The main indications for interference are profuse hæmorrhage and the manifest inability of the uterus to expel its contents.

If the hæmorrhage becomes excessive in quantity the uterus should be emptied; the method to be adopted will be indicated by the severity of the bleeding and the degree of dilatation of the cervix.

Treatment of Incomplete Abortion.—Treatment should be directed to preventing septic infection, to controlling the bleeding and to obtaining a completely empty and involuted uterus. The chief risks associated with retained products are hæmorrhage and sepsis, and it is irrational to leave a piece of placenta in the uterus for any length of time in the hope that it may be expelled.

If the bleeding is severe there may be associated shock. If a patient is moved to hospital by ambulance before the shock is treated the latter may increase to a dangerous degree so that resuscitation becomes impossible. Such patients require immediate first aid, and if a flying squad is available this should be called upon to administer blood in the house before an ambulance takes the patient to hospital. The blood-pressure should be taken and ergometrine, 0.5 mg., should be given at once by intramuscular injection. The patient should be kept reasonably warm; the foot of the bed should be raised and morphine, 16 or 11 mg. (gr. $\frac{1}{4}$ or $\frac{1}{6}$), given. When the blood-pressure has reached a more normal level the patient should be transferred to hospital; there she should be given an anæsthetic and the uterus emptied by the gloved finger or an ovum forceps (page 594). Since the ovum has passed through the cervix it will usually be patulous and admit the finger without the use of dilators. Ergometrine (0.5 mg.) or pitocin (5 units) is administered as soon as the uterus has been evacuated.

In some cases an incomplete abortion is not associated with severe bleeding, but the hæmorrhage continues intermittently for many weeks and is due to a placental polypus. The uterus remains bulky and the cervix slightly dilated. Surgical evacuation of the uterus is then essential, and the patient should be admitted to hospital.

Sometimes it is difficult to decide whether prolonged irregular bleeding after a miscarriage is due to a placental polypus or to a complete abortion followed by an anovular type of bleeding from the endometrium. This may occur before the normal ovarian cycle is re-established. In either event, if the hæmorrhage does not cease

after a reasonable time, curettage is the best and most efficient form of treatment.

In all cases the most careful aseptic precautions must be used and the vulva kept covered by a sterile pad. Involution is frequently slow after the evacuation of an incomplete abortion and, therefore, the patient should be kept in bed for 5 days and should be given some preparation of ergot for 3 days.

Treatment of Septic Abortion.—The gravest risk attached to the process of abortion is sepsis ; infection of the uterine contents may lead to serious pelvic inflammation and to septicæmia. Massive doses of crystalline penicillin, 500,000 units six-hourly, should be given, together with a sulphonamide, until the symptoms and signs subside. It is wise to continue the antibiotic treatment for at least 5 days after the temperature has reached normal. A sterile throat swab should be used to obtain a specimen of secretion either from the vault of the vagina or from the cervical canal through a vaginal speculum as soon as the patient is first seen. This is particularly necessary at present, because it is now common to find penicillin-resistant staphylococci. The swab should be sent to the laboratory at once for culture and to determine the sensitivity to antibiotics and sulphonamides. After the temperature has subsided the uterus may be left to evacuate itself if the ovum is dead as it almost certainly will be. These cases of intra-uterine infection before abortion has commenced are almost always due to criminal interference with an instrument which has introduced pathogenic organisms into the uterus.

In cases of incomplete septic abortion the treatment may be of two kinds. First, it is possible to start giving the antibiotics and sulphonamides at the same time as ergometrine, and then after a short time surgically to evacuate the uterus if necessary. It is common for the temperature and pulse-rate to drop dramatically after the removal of a large piece of placenta which has been blocking the internal cervical os and allowing pus to collect above it.

Secondly, the infection may be treated as described above and, if necessary, a blood-transfusion given (with iron by mouth) to combat the anæmia. When the infection has been cured the uterus is then evacuated—by surgical means if oxytocic drugs fail. The theoretical advantage of this line of treatment is that the protecting mechanism, consisting of a zone of plasma cells and polymorpho-nuclear leucocytes in the uterine wall, is left intact while the infection is still present. The disadvantage is that the hæmorrhage may be severe, and dead placental tissue and blood-clot in the uterus are excellent media for the growth of organisms, particularly of the anærobic variety.

Septic abortion, particularly in virulent infections, may be complicated by a spread of the organisms from the uterine cavity, causing salpingitis, peritonitis, parametritis, or septicæmia. In self-induced abortion the infection may reach the peritoneum directly owing to the passage of an instrument through the pouch of Douglas. If the instrument is passed into the cervical canal with the woman in the squatting position, perforation of the fundus may occur, but penetration sideways into the broad ligament is more likely to take place. This may produce acute parametritis. A strange variety of instruments has been used in self-induced abortion, and any of these may be passed by mistake through the urethra into the bladder. In view of the dangers associated with septic abortion it is always advisable to admit these cases to hospital for treatment.

Treatment of Missed Abortion.—All cases of carneous mole eventually undergo spontaneous evacuation, but sometimes it is many months before this happens. Massive doses of oestrogenic preparations never cause sensitivity of the uterus to oxytocic drugs when the foetus is alive, nor do they do so even when the foetus is dead. It is probably wiser to leave the uterus to evacuate itself spontaneously. If the patient is distressed by the knowledge that she is carrying about a dead foetus, the uterus may be emptied surgically, using either laminaria tents or ovum forceps.

Treatment of Habitual Abortion.—In habitual abortion the cause is usually of maternal origin. It has been suggested that it may be due to deficiency of progesterone secretion, and good results are claimed from the use of progesterone or, alternatively, of high doses of stilboestrol, which are believed to stimulate progesterone secretion. It is difficult to be dogmatic about these treatments, as there are many conflicting opinions on them. Vitamin E has also been tried in these cases, but there is no convincing evidence of its value. If the basal metabolic rate is below minus 10, thyroid deficiency may be the cause of abortion and thyroid extract gr. $\frac{1}{2}$ N.F. should then be given.

In cases of habitual abortion a hystero-gram should be done to exclude an abnormality of development such as a septate or bicornute uterus, but any such condition is seldom found to be the cause. Fibromyomata of intramural or submucous distribution should always be removed if found in a case of habitual abortion. Deep cervical lacerations may cause miscarriage and should be repaired. Retroversion of the uterus should be corrected, if possible before pregnancy occurs, by the insertion of a Hodge pessary so that the pregnant uterus will not drop further back into the hollow of the sacrum. Only very occasionally

is ventral suspension justifiable, as the retroversion is often associated with a generalized hypoplasia of the uterus, which is more likely to be the real cause of habitual miscarriage.

A popular treatment in the past consisted in the implantation of progesterone pellets. Six pellets, each of 25 mg. are introduced below the deep fascia covering the gluteal muscles or under the fascia covering the lateral aspect of the thigh. A local anæsthetic is necessary. If the pellets are placed more superficially they will find their way to the surface. Since the advent of powerful progestational substances which are active when taken by mouth, the administration of progesterone pellets by injection is becoming obsolete. Stilbœstrol may be prescribed. The dosage begins at 5 mg. daily by mouth, starting during the 6th or 7th week (counting from the first day of the last menstrual period). The daily dosage is increased by 5 mg. every 2 weeks until the 15th week, when 25 mg. daily is given. Thereafter the daily dosage is increased by 5 mg. each week. Administration is discontinued at the end of the 35th week, since a drop in œstrogen and progesterone normally precedes the onset of labour.

Limitation of activity at the missed period times must be insisted on, and defæcation should be controlled by the use of mild aperients. Coitus must be avoided altogether.

There is much evidence for saying that there is a functional factor in cases of habitual abortion which may be largely responsible for subsequent miscarriages. It is most important therefore to reassure the patient that she still has a chance of reaching term. The elaborate treatment so often given to these patients may be a potent factor in increasing confidence, thus promoting the chance of a successful delivery.

An occasional case of habitual abortion is due to a deficiency of the internal cervical os. This very rarely is due to a congenital cause and it usually follows previous over-forceful dilatation of the cervical canal for the treatment of spasmodic dysmenorrhœa or for curettage to be performed or when emptying the uterus of an incomplete abortion. On other occasions the whole cervix may be lacerated as far as the level of the internal os during labour at term. Such a weakness of the cervical canal causes a failure to support the foetal membranes when the sac reaches the internal os at the 12th week and after. In these cases the unsupported membranes bulge through the cervical canal and eventually rupture causing an abortion to take place and this process may occur later on at the 20th to 28th weeks of pregnancy. An operation has recently been devised for tying a thick nylon suture or other substance tightly round the cervix close to the internal os, beneath the skin covering the vaginal portion. This may be done during pregnancy

after the 12th week, or later, and is often very successful in causing the pregnancy to reach term, when the suture is then divided and labour allowed to commence.

INTRA-UTERINE DEATH OF THE FŒTUS

In addition to those cases in which the fœtus dies during delivery as the result of pressure and difficult labour, others are seen in which it dies *in utero* before labour starts. This is usually followed by the expulsion of the fœtus from the uterus. In exceptional cases, however, the dead fœtus is not expelled from the uterus at once, but is retained for months.

CAUSE

The causative factors of antenatal death are imperfectly understood. They are in all probability very much the same as those of premature labour since the death of the fœtus is followed by its expulsion within a few weeks. In few cases the cause of death is obvious; in others a consideration of the functions of the placenta will point to its being at fault.

The causes of premature fœtal death may be classified under the following headings:—

1. Those due to *infections*, such as syphilis.

A Wassermann test must be done as a routine early in pregnancy. A positive finding, if confirmed as caused by syphilis, means vigorous treatment of the mother before the child is born in which case a still-birth as a result of syphilitic changes in the placenta and fœtus will be rare. In undiagnosed cases it is common for the fœtus to be born prematurely and in a macerated state which means that death has occurred some time before labour begins.

Any disease which causes a very high temperature may kill the fœtus *in utero*.

2. *General disease*, such as pre-eclamptic toxæmia, essential hypertension, chronic nephritis and diabetes.

One of the most frequent causes of intra-uterine death is due to toxæmia. Fœtal anoxia is produced by reduction in the maternal blood-supply to the uterus due to spasm of the vessels. Added to this there may be sudden separation of the placenta due to an accidental antepartum hæmorrhage or extensive clotting of maternal blood around the chorionic villi.

Essential hypertension acts in the same way upon the blood-supply to the uterine wall. It is common in these cases to find a small fœtus in which growth is deficient and the placenta is often correspondingly

small. A superimposed toxæmia of pregnancy often develops and this may kill the fœtus at once.

Chronic nephritis, if adequately treated in pregnancy, may not result in abortion but when the fœtus becomes viable it is subjected to the risks associated with placental infarction, accidental hæmorrhage and death of the fœtus due to anoxia.

Similarly if a diabetic woman becomes pregnant and the disease is inadequately controlled death of the fœtus *in utero* may easily occur.

3. *Malformations of the fœtus* which are incompatible with life.

If maceration is far advanced by the time the fœtus is born it may be impossible to define the cause in those cases, but abnormalities of the heart and other parts of the body are not uncommonly present.

4. *Postmaturity*.—Controversy still rages over this subject but many consider that it is dangerous to allow a patient to go beyond the 42nd week of pregnancy and in such a case postmaturity is established. There are many pitfalls in making the diagnosis of postmaturity. The placenta at term and after is fairly rapidly becoming less efficient and, if the fœtus is suffering from increasing anoxia, death may occur suddenly without previous warning. Hereditary factors and the pre-diabetic patient also play a part in this condition.

5. Death of the fœtus can occur as a result of an over-zealous attempt at external version which may produce separation of the placenta or strangulation of the cord.

6. *Rhesus Incompatibility: Erythroblastosis Fœtalis*.—It has become recognized that intra-uterine death of the fœtus may rarely result from hæmolytic disease or erythroblastosis fœtalis. This is explained by the iso-immunization theory on the basis of rhesus incompatibility. When a Rh positive man mates with a Rh negative woman and the fœtus is Rh positive, in a small number of cases the mother produces anti-Rh agglutinins as a result of immunization against the fœtal blood. These anti-bodies passing through the placenta may cause hæmolysis of the fœtal red cells. Although this sequence of events commonly results in the birth of a live child in whom one form or another of erythroblastosis may be manifest, there is no doubt that it is responsible for intra-uterine death of the fœtus on occasion—especially during the later stages of pregnancy. The first child of such a mating is not usually affected to any considerable degree. Subsequent children suffer from erythroblastosis when anti-rhesus agglutinins accumulate and increase in potency.

Despite the statements just made it must be realized that the vast majority of rhesus negative women married to rhesus positive husbands have healthy children without any rhesus incompatibility at all.

PATHOLOGICAL ANATOMY

The foetus is usually born in a macerated condition, that is to say its skin is peeling and stained pinkish-brown by the absorption of blood-pigment. The whole body is softened and toneless; the cranial bones are loosened and easily movable on one another. The liquor amnii and the fluid in all the serous cavities contain blood-pigments. Maceration occurs rapidly and may be advanced within 24 hours of foetal death; it is not necessarily accompanied by an offensive odour.

If maceration does not occur the foetus may dry up and mummify, resulting in a so-called foetus compressus or foetus papyraceus. This sometimes occurs when one of twins dies: the dead foetus is then retained, and is born with the membranes of the healthy child.

SYMPTOMS AND DIAGNOSIS

The patient may notice that the foetal movements have not been felt for several days, and the breasts may diminish in size and cease to be tender. Vomiting and nausea, if present, may suddenly stop.

On examination definite signs may be obtained, such as—

Absence of foetal heart-sounds.—Before the 24th week the heart-sounds cannot be heard even in a normal case; but after that period of pregnancy has passed, if a skilled observer repeatedly fails to hear them on careful auscultation it will be strong presumptive evidence of foetal death. This is confirmed if the heart-sounds have been previously heard by the same person. The absence of foetal movements may be noted at the same time.

Cessation of growth of the uterus.—The uterus may be found to be smaller than the duration of the amenorrhœa would warrant, but it must be remembered that a fallacy may occur, as the patient may have conceived during a period of amenorrhœa. A more accurate test is to note how much alteration takes place in the size of the uterus during a fixed period, *e.g.* a month. To do this the bladder should be emptied and the level of the fundus should be accurately noted. The patient is then examined week by week, and the level of the fundus noted. If enlargement is not observed in 4 weeks this is almost certain evidence that a dead foetus is being retained *in utero*.

In some cases the uterus not only ceases to enlarge but gets smaller owing to the absorption of the liquor amnii.

Alteration in the consistence of the uterus.—If the liquor amnii is absorbed to any great extent the consistence of the uterus will become firmer and more resistant, and it will lose its elasticity.

Sometimes a free secretion of colostrum in the breasts may occur a few days after the death of the child.

On vaginal examination the discharge of cervical mucus may be coloured brown by altered blood: this is not a diagnostic sign of foetal death, as it also occurs in concealed accidental hæmorrhage and other conditions. A radiograph will show overlapping of the skull bones (Spalding's sign) and occasionally the presence of gas bubbles in the foetal heart and great vessels. Biological tests for pregnancy may become negative within a week after the death of the foetus, but the tests are not reliable in such circumstances. Intra-uterine death of the foetus is accompanied by a fall in the amount of free oestrogen in the blood.

It will be seen that death of the foetus is difficult to diagnose from a single examination of the patient, and usually the safe course will be to watch the case for a few weeks before deciding that the child is alive or otherwise. Very little importance should be attached to the patient's statements about cessation of foetal movements, since patients often confuse foetal with intestinal movements.

TREATMENT

It is probable that in the majority of cases labour soon follows death of the foetus. There are, however, cases in which the signs of foetal death are clearly present, but labour does not occur spontaneously even after several weeks. In these cases there is no urgent call for interference, since the patient does not suffer from ill-health but occasionally the severe complication of hypofibrinogæmia complicated by amniotic embolism develops. If the patient becomes greatly distressed when she knows the foetus is dead, then labour must be induced and the castor oil and quinine, or pitocin drip, technique may be tried. It may be noted that stilbœstrol and other oestrogens produce no toxic or harmful effects during pregnancy or the early puerperium, but it is impossible to promote abortion in women by oestrogens whether the foetus is alive or dead.

As soon as the puerperium is safely over, it will be necessary to treat the cause of the death of the foetus if possible, so as to prevent a similar termination of a future pregnancy. With the help of the Wassermann reaction and direct examination of the foetal tissues for spirochætes, it should be possible to make a definite diagnosis as to whether syphilis is or is not the cause. If it is, the patient and her husband will require the appropriate treatment.

CHAPTER XXII

HYDATIDIFORM OR VESICULAR MOLE

A HYDATIDIFORM mole consists of a collection of vesicles of varying size resulting from abnormality of the chorionic villi. The vesicles are arranged on a number of stalks which spring from the surface of the chorion, each representing an original villus. These original villi branch, and the branches show the same vesicular formation, so

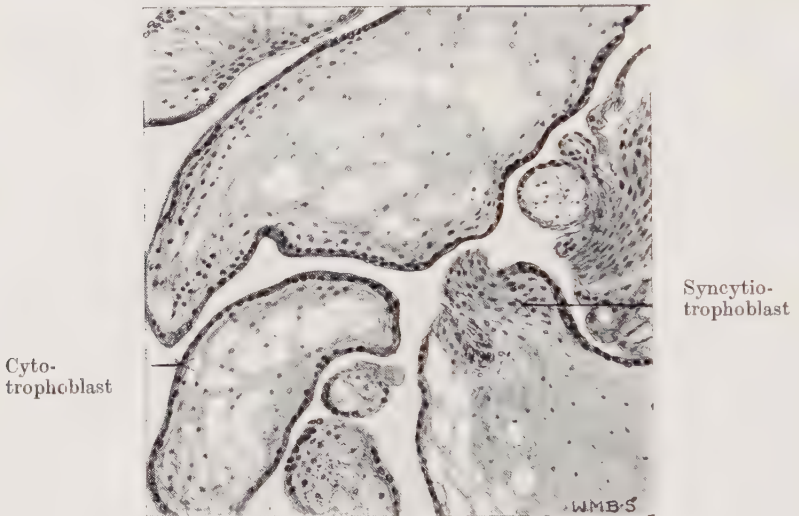


FIG. 84.—HYDATIDIFORM MOLE : MICROSCOPICAL APPEARANCES.

that they come to resemble strings of beads. It is one of the rarer complications of gestation. It has been met with in extra-uterine pregnancy, also accompanying a normal twin, and even in a portion of the placenta of a healthy foetus.

MORBID ANATOMY

It is essentially a chorionic neoplasm. The change in the chorionic villi begins during the first 2 months of pregnancy, when the whole chorion is covered with villi. The amniotic sac is usually indistinguishable, and an embryo cannot be found.

Owing to the enlargement of the villi, the chorion takes up as much room as the whole ovum of a normal pregnancy. In many cases the size of the uterus is greater than that of a normal pregnant

uterus corresponding to the same period of amenorrhœa. This increase in size is chiefly found in cases in which concealed hæmorrhage has occurred into the uterus owing to the separation of the chorion. The undue increase in size may occur in a short time, and may lead to distension of the uterus, accompanied by pain. In other cases there may be no excessive enlargement of the uterus which may be normal or smaller in size than the dates would suggest. Occasionally a fœtus is born normally at term and part of the placenta is found to have undergone vesicular changes.

Vesicles vary in size from the microscopic to about 3 centimetres in the longest diameter. The largest vesicles are usually elliptical, only the smaller ones having a spherical outline.

Microscopically, the vesicles are seen to consist of the usual structure of a chorionic villus, but show an excessive proliferation of both layers of the trophoblastic covering (chorionic epithelium consisting of Langhans layer and syncytium), accompanied by an œdematous or dropsical degeneration of the connective tissue. There are, therefore, at the same time, proliferation and degeneration taking place in the villus. In the smaller vesicles the connective tissue of the villus can still be recognized, but its cellular elements are degenerate and are widely separated from one another by fluid accumulations. In the larger vesicles the connective tissue and the blood-vessels have quite disappeared, nothing remaining but the cyst wall composed of chorionic epithelium containing clear fluid. This fluid was formerly described to result from mucoid or myxomatous degeneration of the connective tissue of the villus. Since, however, the fluid does not contain any mucin the condition is a primary œdematous change with secondary necrosis of the connective tissue.

Both the syncytio-trophoblast and the cyto-trophoblast undergo proliferation forming massive buds. These buds may be large enough to be detected by the naked eye. Such masses of chorionic epithelium attached to the vesicles are almost indistinguishable from the cell-masses which characterize the malignant growth known as a chorion-epithelioma.

This active proliferation of the chorionic epithelium is the essential feature in the pathology of a hydatidiform mole, and must be looked upon as the first manifestation of some unexplained primary disease of the ovum itself. The relatively enormous increase in the two layers of the trophoblastic covering gives to the mole a much increased power of eroding the uterine wall. Clinically important results take place in consequence, and in some cases the villi penetrate completely through the decidua and perforate the uterine muscle. Even the peritoneum may be reached and broken through, so that hæmorrhage

occurs into the abdominal cavity. This power of deep penetration is the distinguishing feature of the so-called malignant hydatidiform



FIG. 85.—HYDATIDIFORM DEGENERATION, SHOWING THINNING OF THE UTERINE WALL.

mole, presumably the frequent precursor of a chorion-epithelioma. Thus every gradation from a simple hydatidiform degeneration of the chorion up to the malignant penetrating mole can be found. Microscopically the tissues from all these varieties are alike, and there is no means of deciding from its histology which mole must be regarded as malignant.

Bilateral theca-lutein cysts are frequently present in the ovaries. They tend to disappear in time after the mole is removed.

When this condition of the ovaries was first noticed, it was suggested that the increased amount of lutein tissue was responsible for the luxuriant proliferation of the trophoblast. The modern view is that the hydatidiform mole is a primary disease of the ovum, and that the ovarian changes are secondary. Aschheim and others have shown that the

amount of urinary gonadotrophins is many times greater than in normal pregnancy.

SYMPTOMS

The chief symptom is bleeding. This has been seen as early as 6 weeks after the last normal period, but usually occurs in the 3rd or 4th month of gestation. Sometimes the abnormally large size of the uterus and the absence of foetal movements may attract attention. Abdominal pain may be complained of, especially if the mole is complicated by concealed hæmorrhage. Symptoms of mild toxæmia are present in a considerable proportion of patients who have large hydatidiform moles. Vomiting may be excessive.

SIGNS

The uterus is generally larger than in a normal pregnancy of the same duration, but not always so and indeed, in some cases, it is smaller. The consistence of the uterus is usually tumid but may be that of normal pregnancy. External ballottement cannot be obtained or foetal heart-sounds heard, except in the very rare cases of twin pregnancy in which only one ovum is affected.

On vaginal examination a foetus cannot be felt, but there may be the usual signs of threatened abortion, namely, slight dilatation of the cervix and hæmorrhage. Later, when the cervix is sufficiently dilated to admit the finger, the mole can be felt and the diagnosis is obvious. The patient may have a slight fever and albuminuria may be present.

DIAGNOSIS

Hydatidiform mole has to be differentiated from threatened miscarriage in an otherwise normal pregnancy. The main points are the size of the uterus, the absence of signs of the foetus, and the passage of the vesicles *per vaginam*. Hydramnios or multiple pregnancy with a threatened miscarriage may be mistaken for a hydatidiform mole. Pregnancy in the presence of fibroids will give rise to a uterus too large for the period of amenorrhœa. Similarly an ovarian tumour impacted in the pouch of Douglas will push the uterus up to an abnormally high level in the abdomen.

In cases associated with albuminuria, œdema, and vomiting, the absence of the signs of foetal life should suggest that the diagnosis is one of hydatidiform mole, and not one of ordinary pregnancy with toxæmia which is almost unknown at such an early stage. An X-ray picture does not show foetal bones.

The biological tests for pregnancy have proved to be of value in diagnosis, because the test is positive with diluted urine. The test is also positive in a higher dilution than normal in cases of hydramnios and twin pregnancy. The diagnosis of hydatidiform mole can be very strongly suspected when the test is positive with a dilution of one in 100; it can be made with confidence when the test is positive in a dilution of one in 500. The test may remain positive with undiluted urine for some weeks after abortion, but if diluted urine continues to give a positive result it strongly suggests the possibility of chorion-epithelioma. Palpation of bilateral ovarian cysts in the presence of a uterus which is too large for the duration of pregnancy is most suggestive of hydatidiform mole. These must not be removed because they will become absorbed after evacuation of the vesicular mole.

PROGNOSIS

Danger to life may arise from hæmorrhage. During the expulsion and still more during surgical evacuation of the mole there may be serious hæmorrhage, and as small pieces are adherent to the uterine wall, the uterus may not retract well, and so hæmorrhage of some severity may ensue and may be fatal to the already exsanguinated patient. An attempt to evacuate the uterus *per vaginam* before uterine contractions have begun is a dangerous procedure and will give rise to most severe hæmorrhage.

Sepsis is a frequent complication owing to the fact that the uterus rarely empties itself completely; and the introduction of the fingers or instruments is required to separate adherent portions.

Erosion of the Uterine Wall.—When the villi penetrate deeply, the wall of the uterus may be so thin that hæmorrhage may occur under the peritoneum, or the uterus may rupture. There is thus a considerable risk of perforating the uterine wall if removal of the mole becomes necessary.

Chorion-epithelioma.—This extremely fatal, though rare, growth is found more frequently after hydatidiform moles than after any other type of pregnancy and, therefore, the possible occurrence of chorion-epithelioma must be taken into account when estimating the risks of hydatidiform mole.

TREATMENT

The treatment of this condition is to empty the uterus carefully and thoroughly, and to promote contraction and retraction. If uterine contractions have not begun and the cervix is still closed, the best method of treatment is to insert laminaria tents into the cervical canal and await the onset of labour. In many cases, in which the cervix is already dilated, spontaneous evacuation of the whole or greater part of the mole may be achieved. Every opportunity should be given to encourage expulsion by the uterus itself, as digital removal may give rise to profuse hæmorrhage. Ergometrine or pitocin is administered; vaginal plugging may have to be used if hæmorrhage is severe. So far as possible, the mole is to be squeezed out from above rather than pulled out from below.

In some cases, however, it is found necessary to extract the mole or remaining portions thereof from the uterine cavity. For this purpose the fingers can be used, a procedure which is facilitated by the introduction of the whole hand into the vagina. The greatest care must be exercised in scraping with the fingers, as the uterine wall may be perforated all too readily when villi have penetrated deeply. The

use of ovum forceps may be employed if the uterus is contracting well. It is helpful to douche from time to time and to wipe out the cavity with gauze on a sponge holder when the uterus is sufficiently contracted. Whilst the wall is being gently scraped with the fingers, the external hand should be applied to the abdomen to steady and define the uterus. The operation is one of considerable severity and it may take a long time to complete.

A diagnosis of hydatidiform mole may be made by quantitative biological pregnancy tests and clinical considerations before the extrusion of vesicles and before the cervix is dilated. In these cases the alternative lines of treatment are artificial dilatation of the cervix as described above and evacuation of the mole *per vaginam*, or abdominal hysterotomy. Most obstetricians prefer the former, but when the uterus is equivalent in size to a 20 to 24 weeks pregnancy and uterine contractions have not commenced it is often wiser to evacuate the mole by the abdominal route. If the patient is near the menopause, hysterectomy should be considered, particularly as the development of chorion-epithelioma is comparatively high in women over 40.

If the lochia continue coloured with blood at the end of 2 weeks, the uterus should be curetted and the scrapings submitted to an expert pathologist. In any event it is wise to curette the uterus thoroughly two weeks after a spontaneous evacuation of a vesicular mole because vesicles almost always remain embedded in the decidua. This will cause the pregnancy test to remain positive. Chorion-epithelioma secondary to hydatidiform mole does not, however, always lead to persistence of red discharge. It does not necessarily persist when the growth lies within the wall of the uterus rather than projecting into its cavity. Hence it is sound practice to have a biological test for pregnancy made every month commencing at the 4th week after the evacuation of the mole. When the test is negative on two occasions the patient may be regarded as cured.

For the diagnosis and treatment of chorion-epithelioma the reader is directed to Ten Teachers, *Diseases of Women*, Chapter XXXVI, page 378.

CHAPTER XXIII

HYDRAMNIOS

HYDRAMNIOS means the presence of an excessive quantity of liquor amnii. It is difficult to say exactly what the amount must be in order to merit the term *excessive*, because the normal quantity varies from 300-1500 c.c. (10 to 50 ounces). Probably quantities less than 4 pints at full time would not be clinically recognizable as hydramnios.

For the composition of the fluid and the theories as to its origin see page 30.

Hydramnios almost always occurs in the second half of pregnancy. If it becomes apparent at as early a time as 20 weeks this strongly suggests the presence of uniovular twins. Hydramnios occurs more often in multiparæ than primigravidæ and the source of the excess may be foetal or maternal in origin. There may be an excess of liquor in only one sac of a twin pregnancy. Maternal causes of this condition include :—

(a) Diabetes, when hydramnios is often present, with an excessively large baby, toxæmia of pregnancy and a high foetal death rate. The presence of sugar in the liquor amnii which is in excess in such a case theoretically may stimulate the production of an excess of liquor.

(b) Pre-eclampsic toxæmia. In these cases hydramnios may occur and the cause is unknown.

(c) In cases of congestive cardiac failure an abnormal amount of fluid may be secreted into the amniotic sac, as elsewhere.

Foetal causes are as follows :—

(a) Foetal abnormalities. The commonest is the anencephalic monster which probably is often incapable of absorbing liquor through the intestinal tract.

In this respect a single pregnancy with hydramnios as a complication may have an œsophageal atresia with inability to swallow. This complication must always be borne in mind if regurgitation of fluids occurs in a baby just after birth.

Other gross abnormalities of development may be present and spina bifida is common.

Very occasionally a chorio-angioma is found to be present in the placental surface and is associated with hydramnios.

(b) Hydrops foetalis may be complicated by hydramnios.

VARIETIES

Two varieties must be distinguished, chronic and acute.

Chronic Hydramnios is the more common form. It is a slowly progressive variety, and is not usually apparent until the second half of pregnancy. When hydramnios occurs early in the second half of the pregnancy it is often associated with twins. When it occurs late in the second half of pregnancy it is more likely to be associated with foetal abnormalities. As a general rule, the chronic variety does not give rise to much disturbance. The patient may complain of an undue size of the abdomen, and may notice undue mobility of the foetus. If the abdomen becomes greatly distended she may complain of flatulence and dyspepsia; also, owing to the pressure upwards upon the diaphragm, of attacks of palpitation and dyspnoea; she may be somewhat cyanosed. Varices and oedema of the legs are liable to develop. It is extraordinary, however, how tolerant the abdomen may be of even a large amount of fluid provided it has accumulated slowly.

Acute Hydramnios is very rare. The fluid accumulates rapidly, and a much slighter degree of distension may lead to disturbances which are sufficiently serious to endanger the life of the patient. Owing to the rapid secretion of the fluid the uterus and abdomen cannot accommodate themselves to the increase of pressure. The main symptom is abdominal pain of rapidly increasing severity. This is accompanied by severe and persistent vomiting. Pressure symptoms may supervene: dyspnoea, pain under the diaphragm and oedema of the legs.

PHYSICAL SIGNS

The abdomen is larger than is usual for the period of the pregnancy, and the fundus of the uterus is at a higher level. The abdominal wall may be greatly thinned and the recti widely divaricated. The abdomen is tense and tender. Palpation is difficult: it is usually impossible to feel the foetal parts, owing to muscle spasm, tenderness and excess of liquor amnii. On the other hand, the foetus is unduly mobile and external ballottement may be well marked. Owing to the undue mobility of the foetus a malposition frequently occurs. Fluctuation and a fluid thrill are obtained with unusual ease. The foetal heart-sounds are difficult to hear, being muffled by the presence of an excessive amount of fluid between the uterine wall and the foetus. The mother's pulse-rate increases. Albuminuria occasionally occurs. Oedema of the abdominal wall may be present.

DIAGNOSIS

Chronic Hydramnios.—The facts already enumerated will serve to differentiate chronic hydramnios from normal pregnancy. There are, however, several other causes of undue enlargement of the abdomen during pregnancy besides hydramnios.

Multiple Pregnancy.—Sometimes the differential diagnosis between hydramnios and twin pregnancy is almost impossible on clinical examination, especially as twin pregnancy is sometimes associated with hydramnios. In this case the hydramnios is usually detected, and the multiple pregnancy is not diagnosed. When, however, the twin pregnancy is not complicated by hydramnios, a diagnosis can be made more easily because the uterus is firmer to the touch, and palpation reveals more than one foetal head and an unusual number of small parts. Further, more than one foetal heart may be heard in different places and beating at different rates. An X-ray should be taken as a routine in all cases of hydramnios.

Ovarian Cysts.—If pregnancy does not co-exist with an ovarian cyst, the cyst may be diagnosed by the absence of the symptoms of pregnancy, by the mobility of the tumour and by the fact that it does not harden on manipulation; neither can a foetal heart be heard. Bi-manual examination will show that the uterus is not enlarged, and is separate from the tumour. The biological pregnancy tests are negative.

When pregnancy does co-exist with an ovarian cyst the diagnosis from hydramnios is more difficult. It depends upon the identification of two tumours, only one of which shows the characteristic signs of the pregnant uterus, including intermittent contractions. A radiograph will show the outline of the foetal skeleton in one of the tumours, which is smaller than the abdominal enlargement would suggest.

Hydatidiform mole may cause an undue enlargement of the uterus. But a foetus cannot be palpated and a foetal heart cannot be heard. There may also be a history of a blood-stained discharge, and very rarely, of the passage of vesicles. The pregnancy test will be positive in marked dilution.

Acute Hydramnios.—In acute hydramnios the diagnosis is often difficult on account of œdema of the abdominal wall. Care must be taken to exclude intestinal obstruction because of the accompanying vomiting and distension. Certain cases have simulated concealed accidental hæmorrhage and *vice versa*.

EFFECTS ON PREGNANCY AND LABOUR.—Owing to the undue mobility of the foetus a malpresentation is not uncommon. There is a liability to premature labour, which occurs in 50 per cent. of cases. The labour is usually protracted owing to the weak uterine contractions, due to the over-distension of the uterine muscle. The membranes are prone to rupture prematurely and the umbilical cord to prolapse. After delivery there is a liability to postpartum hæmorrhage from atony of the uterus.

TREATMENT

There is no known method of controlling the production or absorption of amniotic fluid. In the chronic variety, the minor grades of hydramnios rarely require treatment. The acute cases and a few of those chronic cases in which the pressure symptoms are so severe as to cause dyspnœa and cardiac embarrassment demand relief by drawing off the liquor. If the child is near term or X-rays show a definite foetal abnormality, as is common in acute cases, there is no object in attempting to delay the onset of labour; it should be induced by rupturing the membranes.

In cases in which the child is not yet near term and an abnormality does not appear to be present on X-ray examination, the uterus may be tapped through the abdominal wall. Under anæsthesia, a part of the uterus where foetal parts are easily felt is selected in order to avoid risk of injury to the placenta and a spinal needle is pushed through into the amniotic cavity, first making sure the bladder has been emptied by passing a catheter. The liquor will usually run out freely, but it may be necessary to aspirate, as occasionally the needle may become blocked with vernix. Up to 4 pints (2·4 litres) may be safely removed. Although there is some risk of labour following this operation a few patients will continue in comfort to term. The operation may be repeated if necessary. There is always a slight risk of perforating a placental vessel and producing hæmorrhage of foetal origin into the amniotic sac.

When a very great deal of liquor amnii is present it is risky to rupture the membranes from below and allow a large quantity of fluid to escape suddenly. The placenta may separate producing a severe antepartum hæmorrhage.

DEFICIENCY OF LIQUOR AMNII

(Oligohydramnios)

This condition is characterized by an unduly small amount of amniotic fluid, which may be represented by only a few cubic

centimetres. Extreme cases are rare and the cause is not known. It has occurred in cases in which the foetus has an imperforate urethra. The foetal skin is markedly thickened, and is dry and crumpled in appearance.

Almost complete absence of liquor may lead to intra-amniotic adhesions, and certain foetal deformities occur. Labour is likely to be complicated owing to malposition of the foetus, and uterine inertia is common.

CHAPTER XXIV

DISEASES ASSOCIATED WITH PREGNANCY

PYELITIS, PYELONEPHRITIS, URETERITIS AND CYSTITIS DURING PREGNANCY

Definition.—Patients who pass pus and bacteria from the kidneys in the urine during pregnancy are suffering from pyelitis which means inflammation of the renal pelvis. The disease usually occurs between the ages of 20 and 30 years, and is far more frequent during the first pregnancy. It has been found in 1 per cent. of unselected antenatal patients. The symptoms appear, as a rule, during the fifth and sixth months of pregnancy, but they may arise at any time, often in the puerperium between the sixth and tenth days, but earlier if there has been pyelitis in pregnancy.

Relapses during the same pregnancy may take place ; and attacks in subsequent pregnancies have been noted in about 10 per cent. of cases.

MORBID ANATOMY

The condition is rarely fatal. The post-mortem lesions of the milder cases, therefore, are not known. The following description refers only to the severe cases.

The Kidneys.—Fifty-five per cent. are affected on the right side, 35 per cent. the left, and 10 per cent. on both sides.

The kidney is of a pale colour and softer than the normal. It is usually enlarged by the distension of the pelvis which is nearly always present. The cut surface shows some dilatation of the pelvis, which is injected, thickened, and roughened. Within the renal cortex small abscess cavities are frequently discovered (pyelonephritis) and streaks of pus may be seen radiating outwards in the medulla from the renal pelvis. Microscopic section shows little change in the substance of the kidney except in the region of the abscess cavities, where there is evidence of inflammatory reaction.

The Ureters.—One or both ureters are usually dilated above the brim of the true pelvis, although apparently normal below that level. The lining membrane is thickened and injected. The amount of dilatation is usually not more than that of a lead pencil, but cases have

been observed in which the dilatation was so great that the ureter resembled a piece of small intestine. It may be convoluted or kinked in places, and adhesions may be present between it and neighbouring structures. Strictures of the ureter are occasionally found. The kinking and dilatation of the ureter may be shown in a pyelogram.

The Bladder may not show any abnormality. In a certain proportion of cases, however, there are signs of cystitis. This may have preceded the attack of pyelitis, or may be the direct result of it.

PATHOLOGY

Dilatation of the ureters is a common accompaniment of pregnancy, and it has been shown that in about 80 per cent. of pregnant women there is marked stasis in the right ureter and to some extent in the left ureter also. The dilatation may be caused by pressure of the enlarged pregnant uterus on the ureter at the brim of the pelvis. The right ureter is more likely to be involved on account of the tendency of the uterus to incline towards the right side, and to twist upon its vertical axis so that the left side lies more to the front. The right ureter also lies further from the middle line than the left, and is, therefore, less protected by the projection of the sacral promontory. Pyelograms have proved the presence of dilatation often associated with marked kinking which together cause urinary stasis, and encourage the growth of micro-organisms.

In addition to mechanical factors causing dilatation of the ureter, there is evidence to suggest that there may be atony of the ureteric musculature during pregnancy. It has further been suggested that this atony is caused by the inhibitory effect of progesterone upon the posterior-pituitary hormones.

The Infecting Organism.—An organism of the *Bacillus Coli* group is present in nearly 80 per cent. of cases. The organism has been obtained not only from the bladder, but directly from the kidney by ureteral catheterization, contamination from the bladder being thus excluded. Other organisms are occasionally found, such as the streptococcus or staphylococcus.

The Path of Infection.—There are three possible paths of infection by which the organism reaches the kidney :—

1. By the blood-stream (descending infection).
2. By the urinary tract (ascending infection).
3. By the intestinal lymphatics (direct infection).

1. *By the Blood-Stream.*—This method of infection is considered to be the most likely. Even during health the body may contain a few wandering organisms which have entered the blood-stream, possibly through the tonsils or from the intestinal tract. In health they are excreted by the kidneys without causing symptoms. Should the kidneys be damaged there is a liability that these organisms may settle down in the damaged tissue. Such damage may exist in the urinary tract during pregnancy, as shown by the dilatation of the ureters and renal pelves. This view is based upon experimental proof. The ureters of rabbits have been tied, and bacillus coli and streptococci have been injected into the veins of the ear. In every case pyelonephritis has followed, and the causative organism has been recovered.

Additional support is given to this view by the observations that bacilluria occurs in 10 per cent. of pregnant women, bacillus coli being found in 7·5 per cent., although there is no evidence of urinary infection. It is argued that these organisms are in process of excretion by the kidneys. On the other hand, it is not often that the organism can be discovered and grown from the blood, even if the blood is examined when the symptoms are acute. In a few instances, however, the organism has been obtained in this way.

2. *By the Urinary Tract.*—This view supposes that the organisms ascend to the kidney along the course of the bladder and ureters. Those who accept this view point out that some cases of acute pyelitis follow an attack of gastro-enteritis and that the female urethra, on account of its anatomical relations, is peculiarly liable to contamination from the rectum. That such contamination occurs is not very probable, but it is a fact that cystitis occasionally precedes the pyelitis. It has been conclusively demonstrated that even in the absence of any clinical evidence of cystitis the bladder may contain the bacillus coli. The question that next arises is, can they ascend to the kidney? There is sufficient evidence to prove that they can do so, notwithstanding the natural valvular action of the ureteric orifice. It has been shown that the organisms travel up in the peri-ureteral lymphatics. If one ureter of a rabbit is ligatured, and coliform bacilli are injected into the bladder, the rabbit will develop a pyelonephritis on the same side, and the bacilli can be seen within the lymphatics of the ureter. It is also theoretically possible for organisms to reach the peri-urethral lymphatics from an infected cervix uteri.

3. *By the Intestinal Lymphatics.*—The organisms may pass directly from the intestinal tract to the kidney. The kidneys are in close anatomical relation to the ascending and descending colon, and as a lymphatic connexion exists between the renal pelvis and these portions of the intestine, it is possible that organisms may reach the kidney in

this manner. The frequency of a preceding attack of constipation or diarrhoea has already been referred to. But if this were the usual path of infection it is difficult to understand why the streptococcus *fæcalis*, which is so commonly present in the intestine at this level, is not more often the causative organism.

It is probable that infection may occur by means of any of the three paths which have been mentioned, especially if there is any tendency to urinary stasis in the pelvis of the kidney.

SYMPTOMS

Pyelitis in pregnancy may be acute or chronic.

(a) *Acute Form*.—The patient, usually a primigravida and at about the 24th week of pregnancy, is suddenly seized with an acute attack of abdominal pain, which is felt in the lumbar or iliac region of one or both sides, generally the right. The temperature rises suddenly to about 103°-104° F. (40° C.), and may be accompanied by a rigor; the pulse-rate is rapid and often remains about 120 per minute for several days. The patient frequently appears profoundly ill, and complains of obstinate constipation or severe vomiting and diarrhoea. It is a characteristic of the disease, however, that the patient improves rapidly in appearance after the rigor is over. The abdomen may be distended and is tender, especially over the region of the affected kidney.

(b) *Chronic Form*.—In this form the symptoms are not so characteristic, and the mode of onset is subject to variations. The symptoms may manifest themselves by a gradual onset with malaise and increasing lumbar pain, by cystitis, gastro-intestinal disturbances, or by symptoms suggesting pleurisy and pneumonia. The temperature is slightly raised and irregular; on palpation the kidney may be tender and feel enlarged. The tenderness of the kidney often subsides after the free passage of pus in the urine, and there is a tendency for the pain to subside in one lumbar region and later to develop upon the opposite side. The attack in some cases is extremely mild; there may be pain but no other symptom, or the patient may have rigors without any apparent cause.

The Urine.—In a certain number of patients there has been evidence of a preceding cystitis, and this complication is liable to follow an acute pyelitis. At first the urine is diminished in amount and of high specific gravity. Later the amount is much increased, owing to the large amount of fluid given in the course of treatment. On examination of a specimen drawn off by catheter, or obtained directly from the kidney by ureteric catheterization, the urine in the earliest

stages contains only bacilli but soon the urine becomes turbid, contains pus and flocculent debris; the reaction is almost invariably acid. It is seldom offensive. A pure culture of the coliform bacillus is usually obtained. The centrifuged deposit contains large quantities of these organisms, pus cells, epithelial cells, some red blood-corpuscles, and albumin.

The Blood.—The white cell count is raised beyond that which is regarded as normal during pregnancy; in many cases there is a leucocytosis of from 20,000 to 30,000 per c.ml. affecting chiefly the polymorphonuclear cells.

DIAGNOSIS

The diagnosis is based upon the occurrence of a raised temperature, bacilluria, pyuria, and the presence of abdominal pain and tenderness in the situation of the kidney or down the line of the ureter. It should always be thought of when there is renal tenderness during pregnancy. Care must be taken, when examining the kidney, that the affected side is uppermost, the patient being on her side, so that the uterus does not obscure the palpation of the kidney. The diagnosis is confirmed by examination of the urine obtained by catheter when the presence of coliform bacilli is proved.

The differential diagnosis has to be made from :—

(a) Cystitis. The tenderness over the kidney and the acidity of the urine are the features of pyelitis. In a patient suffering from cystitis alone, the pus is in greater amount and the pain is situated over the bladder. The two conditions may, however, co-exist.

(b) The acute variety may be mistaken for appendicitis or biliary colic, owing to the suddenness of its onset and the severity and situation of the pain. In pyelitis there may be tenderness in the iliac fossa and abdominal rigidity; the degree of fever is higher and may be accompanied by rigors, which are rare in appendicitis; the tongue is cleaner, vomiting less persistent and abdominal distension less marked. If care is taken to examine the urine, mistakes are not likely to be made.

(c) The more chronic variety may be mistaken for influenza or typhoid fever, or even for lumbago.

(d) In the puerperium the condition must be distinguished from fever due to acute endometritis or septicaemia.

When abdominal pain exists it is necessary to make sure that the symptoms are not the result of pleurisy or pneumonia.

The differential diagnosis of pyelitis may become difficult, particularly in acute cases, owing to temporary blockage of the

affected ureter, clear urine from the unaffected side being passed. In such cases the urine may suddenly contain large quantities of pus and micro-organisms. It is necessary, therefore, to take several specimens at short intervals, as a single negative finding is not conclusive.

PROGNOSIS

In the majority of patients, under suitable treatment, an improvement takes place within a few days, the pain subsides, the temperature falls, and the urine contains less pus. It must be remembered, however, that even after all the symptoms have completely subsided, the urine frequently contains micro-organisms, and they may continue to be present, if untreated, for several months or years, which explains the liability of patients to relapse.

In a certain number of cases the course is not so favourable. A pyonephrosis may develop, and, rarely, a perinephric abscess. The formation of a pleural effusion can occur, and the bacillus coli has been recovered from the pleural fluid.

The maternal mortality is low. Improvement nearly always follows medical treatment and it is very seldom necessary to terminate the pregnancy. The presence of much pus in the urine is not necessarily a bad sign, for it may be an indication that the pus can drain away freely. When death takes place it may be due to septicæmia. Abortion or premature labour may occur in the more severe cases. The child is not infected by the organism.

As regards the prognosis in subsequent pregnancies, if the urine is sterile before the onset of a second pregnancy, pyelitis will be likely to recur in one in five cases; but if the infection has not cleared up further acute attacks are almost certain.

TREATMENT

The patient must be put to bed in order to obtain rest and for the relief of pain. If the right kidney is the one affected, she will obtain more relief if she lies mainly upon the unaffected side, with the knees flexed to relax the abdominal muscles.

An essential part of the treatment is the administration of large quantities of fluid, at least 5 to 6 pints daily, *e.g.* barley water and fruit juice in water. The fluid is necessary to flush out the kidneys and to carry away any infected material from the renal pelvis. As the bacillus coli does not flourish in an alkaline medium, the urine should be made alkaline by sodium citrate with sodium bicarbonate 2.0 g. (30 gr.) of each, given every 4 hours till the urine is alkaline. The pH of the urine should be kept at about 7.6.

It is generally found that as soon as the reaction of the urine becomes alkaline, the patient loses her pain, and the temperature becomes normal, although the bacillus is still to be found in the urine.

A catheter specimen of urine should be cultured and the organism tested for sensitivity to the sulphonamides and antibiotics.

Chemotherapy.—The sulphonamide group of drugs has largely replaced other measures, such as mandelic acid, in the treatment of this disease. Sulphonamide treatment produces its best results when the infection is due to bacillus coli. The results are not always entirely satisfactory in mixed infections: penicillin combined with sulphonamide therapy may well provide the remedy in occasional refractory cases of this nature. Sulphanilamide has been widely used in Britain, on account of its availability and the infrequent production of renal complications; but sulphadiazine is the one now in most common use by itself or in association with sulphathiazole and sulphamerazine (as sulphatriad).

Unnecessarily high doses of the sulphonamides have previously been recommended. The administration of 3·0 g. daily maintains a satisfactory concentration of the drug in the vast majority of cases. Causative organisms are usually eliminated within 4 days. A smaller dosage is continued until the urine has been sterile for 3 days. The urine should be re-examined 4 days later and again at intervals, as pyelitis of pregnancy is apt to recur.

Restriction of fluid intake in order to raise the concentration of the drug in the urine is dangerous and five pints of fluid should be taken daily: fluid intake and urinary output should be carefully maintained. Concurrent alkaline therapy is necessary. If the urinary tract is infected with the coliform bacillus, it can usually be made sterile by an intra-muscular injection of streptomycin, 0·5 g. twice a day for 2 days only, if need be, but should only be used for the particular patient.

Surgical.—As a rule these medical measures suffice, and the patient shows early improvement. It is necessary to make it clear that further measures are seldom required and must be reserved for exceptional cases. This is more than ever the case since the introduction of the sulphonamides. When, however, there is no improvement the temperature remains high, the pulse-rate frequent, and when the urgency of the symptoms suggests that there is an infection of the kidney substance, or if the case becomes chronic and shows no tendency to clear up, the renal pelvis should be drained by a ureteric catheter, which is left *in situ* for 12 to 24 hours. Irrigation is usually unnecessary.

The simplest method of allowing the pus free exit from the kidney is to remove the influence exerted by the pregnancy upon the ureter. This is done by terminating the pregnancy, but it must be emphasized that this measure is rarely necessary. The results are usually favourable, and the pyelitis does not appear to increase the risk of infection of the uterus during the puerperium. It may be advisable, when the symptoms develop late in the pregnancy, to delay the induction of labour for as long as possible so that a living child may be obtained.

If a pyonephrosis develops, nephrotomy and the formation of a urinary fistula is the best practice. Nephrectomy is not advised, for the remaining kidney may be already involved in the infection, or may later become the site of disease. Nephrectomy should be reserved for those cases in which the kidney is completely disorganized and functionless, or there is a persistent fistula.

Pyelitis during the Puerperium.—The symptoms appear between the 6th and 10th days as a rule, and are frequently accompanied by rigors. It is by no means uncommon to mistake such cases for puerperal septicæmia or appendicitis; to avoid this error, care should be taken to examine the region of the kidneys for tenderness, and the urine for the presence of organisms.

Retention of Urine.—Retention of urine in pregnancy almost always comes into the category of acute retention, though there may be a preceding interval of difficulty and sometimes of retention with overflow. The most common cause is impaction of the retroverted gravid uterus about the 12th week of pregnancy, when its growing size about fills the pelvis, and by compressing and elongating the urethra interferes with the release mechanism at the bladder neck. Another cause of retention in pregnancy, though rather rare, is a pelvic hæmatocœle resulting from a slowly leaking ectopic gestation, usually tubal. Blood accumulates in the pouch of Douglas, forms a clot of ever-increasing size which is walled off above by intestines and finally if pain or collapse do not call surgical attention to it, causes acute retention of urine for the same reason as was mentioned in connexion with retroverted gravid uterus. The patient with acute retention from retroverted gravid uterus will be in pain and will have a tender, tense (almost hard) swelling rising from the pelvis often to above umbilical level. If the urine is infected there will be fever, a coated tongue and probably tenderness in the loins as well. On pelvic examination there will be a tense prominent swelling filling the pelvis and the softened cervix will be felt, often with some difficulty, up behind the symphysis pubis where

it is jammed by the pregnancy behind it. Sometimes by this time abortion is threatening so there may be vaginal bleeding as well.

Conditions which may simulate this clinical picture are pelvic hæmatocœle (as already mentioned) and, if it becomes infected, pelvic abscess, hydatidiform mole and twisted ovarian cyst in pregnancy. A careful history followed by examination and the passage of a catheter will usually reveal the true state of affairs. The treatment in the first place is to decompress the bladder and then to encourage the uterus to become anteverted. In emptying the bladder there is no need for slow decompression if the retention is acute, as denoted by the history, the pain and finding the bladder tender. If it is not so acute then it may be advisable to decompress the bladder more slowly, taking 12 to 24 hours to do so. Scrupulous care should be taken to avoid introducing infection in passing the soft rubber or terylene catheter and a specimen of urine is sent for bacteriological examination. If it is infected chemotherapy should be begun immediately. When the bladder has been emptied the catheter is kept in place until the uterus becomes anteverted. To encourage it, the patient is made to lie face downwards for long intervals. If after 48 hours or so the position is unchanged, manual replacement by pressure on the retroverted uterus with the gloved fingers in the posterior fornix may be needed, possibly with the patient in the knee chest position. Very occasionally replacement under anæsthesia may be called for. If the catheter has to be left in the bladder for more than a few hours, it is advisable to prescribe chemotherapy to prevent urinary infection.

If the retroverted gravid uterus cannot be manipulated forwards there is a strong possibility that it is fixed by adhesions. Laparotomy would then be necessary and the uterus freed and brought forwards; this procedure is only very uncommonly needed. Neglected cases of retroverted gravid uterus are now seldom seen but in the past sometimes caused serious bladder infection, resulting in necrosis, not only of the epithelial lining but also the muscle layer.

Again, if this disaster is avoided and correction does not fully occur spontaneously, the pregnancy either ends in abortion and spontaneous cure or occasionally it advances by growing upwards into the abdomen at the expense of the anterior uterine wall by a process known as anterior sacculation. Under such conditions vaginal delivery is impossible because the head is lodged in a cul-de-sac of the posterior uterine wall low down in the pelvis while the cervix is at a higher level behind the symphysis pubis. Cæsarean section is the correct method of delivery in this rare condition.

ANÆMIA IN PREGNANCY

Physiological Changes. A significant increase in the plasma volume of the blood in pregnancy has been recognized for more than thirty years, and this knowledge in the past has led to the acceptance of a lowered level of hæmoglobin during middle and late pregnancy as being entirely due to physiological causes. The degree of hæmodilution varies considerably, but on average there is found to be a 20 to 25 per cent. increase, and this is maintained until a little before term, when there is an appreciable decrease, but the non-pregnancy level is not reached until about 2 months after delivery. Together with the plasma there is also an increase in red-cell volume and in hæmoglobin content, though not to so great an extent.

The way in which these changes are brought about is not known, though the posterior part of the pituitary gland is thought to play a part; nor is the reason for the increased fluid volume of the blood any better understood and sound physiological basis is still lacking.

More recently doubt has been cast on the purely physiological basis for these changes and alternatively they have been regarded as having an abnormal or pathological significance at least in the more pronounced examples of depressed hæmoglobin readings. This is merely another way of saying that although hæmodilution does occur in pregnancy, a more common reason for a lowering of the hæmoglobin is iron deficiency. Until more facts are known, the dividing line between anæmia and hydræmia will be uncertain. Published figures on this subject point to a hæmoglobin level of 75 to 80 per cent. (11·8 g. per cent.) as being the lower limit of normal. Yet others have convincing evidence that this level can be raised by suitable forms of iron therapy and should never be below 81 per cent. (12 g. per cent.)

Iron Deficiency Anæmia.—A deficit iron balance in a woman who is not pregnant and has no debilitating disease may arise through either a deficient intake, through poor diet, or a failure to absorb, or an abnormally heavy loss from menstruation, or other bleeding. Figures vary, but the average diet in Britain is said to provide at least 5 mg. of iron daily or approximately 140 to 150 mg. a month. The monthly loss of iron due to menstruation naturally shows as wide a variation as does the loss itself from patient to patient, but has been found to average 14 to 28 mg. of iron; though with moderately severe menorrhagia it may rise to 125 mg. a month. Therefore, so long as the diet is adequate and absorption good, iron deficiency anæmia should not occur except in cases of severe menorrhagia. Furthermore, in the healthy woman the body stores of iron, amounting to 1·0 to 1·5 g., provide a safeguard

against iron depletion by any unexpected short-lived demand. If the demand proves a long term one, the iron stores will soon be exhausted and the dietetic iron supply may prove inadequate in preventing the hæmoglobin level from falling.

In pregnancy there is a change in circumstances, both as regards supply of iron and demand. With regard to supply, the amount of iron ingested in the diet may be greatly reduced because of either nausea and vomiting in the early months and vagaries in appetite or choice of food later. The amount of iron absorbed, not only depends on the amount proffered to the gastro-intestinal tract, but also on the ability of the intestinal tract to absorb it. An adequate hydrochloric acid content in the gastric juice is essential for iron absorption and the association between hypochlorhydria, even achlorhydria, and hypochromic anæmia in pregnancy has been confirmed in many studies. The evidence in favour of this hypothesis is to be found in the benefit derived from prescribing hydrochloric acid when it is deficient.

This tendency for hypochlorhydria to develop appears to occur in an otherwise uncomplicated pregnancy, and clears up during the puerperium.

The change in demand for iron from the non-pregnant to the pregnant state comes about from the substitution of foetal requirements for menstruation. The amount of iron that has to be built up for the foetus (400 mg.) and the placenta and uterus (150 mg.) requires an absorption over the 40 weeks interval (less at the beginning and more towards the end) of at least 2 mg. a day. Yet one study has shown that the maximum absorbed from an average diet in pregnancy is no more than 1 mg. daily. As a guide to the correct management of the increasing demands for iron in pregnancy, it has been concluded that in the first, second and third trimesters of pregnancy, the requirements of iron are 1 mg., 4 mg., and 10 to 12 mg. a day respectively.

It becomes obvious, therefore, that additional iron, with or without hydrochloric acid, must be supplied throughout pregnancy. Whether or not this will be in tablet or other form by mouth, or by the parenteral route will depend on the response to therapy. The commonest form of iron to give by mouth is ferrous sulphate tablets 195 mg. (gr. 3), two tablets being given three times a day. Some patients cannot tolerate this preparation so a slightly more expensive form, ferrous gluconate, may be tried, one tablet three times a day. Apart from these there are many different forms now in which iron is exhibited and it is usual to be able to find one form that suits the patient. Whatever form is chosen it is as well to begin therapy in reduced dosage and gradually increase it to the required amount. Ascorbic acid is frequently

prescribed as well as iron, because there are some indications that it may help absorption of the iron.

When hypochlorhydria is not evident and the response to iron by mouth is poor, especially if term is drawing near the parenteral route should be chosen. In such refractory cases iron may be given intravenously or intramuscularly with excellent results, yet it is the confirmed belief of the authors that the disadvantages of intramuscular iron injections form unsightly and prolonged pigmentation unless they are given very deeply and skilfully, overwhelmingly outweigh whatever meagre advantage the method might have theoretically over the intravenous route. For the latter to be safe, a small test dose of 25 mg. is given and if there is no reaction, a full course of injections (100 mg. a day) may be given for upwards of 10 days. In favourable cases the response after a few days is rapid, the hæmoglobin level rising by 2 to 3 per cent. a day and will continue to rise for some days after the course has been completed.

When there is not even time to correct the anæmia by intravenous iron and the degree of anæmia warrants it, blood-transfusion is indicated. Packed celled transfusion is to be preferred to whole blood if it is obtainable, to avoid giving unnecessary bulk in the correction of this essentially non-acute form of anæmia; the transfusion must be given slowly.

Antenatal Care and Blood Studies.—A blood film is not made as part of the normal routine hæmatological examination in early pregnancy; the hæmoglobin level is estimated by the photo-electric cell method, which has an accuracy of ± 2 per cent. If the level is above 80 per cent. no further action would be taken routinely, and iron would be given as usual by mouth. A reading much below this would indicate the need for a full blood-count.

The hæmoglobin level is again checked routinely between the 32nd and 34th week. If it is significantly below the reading in early pregnancy, the patient would be questioned carefully about her diet and whether or not she is taking her iron tablets regularly. Should the fault seem to be here, advice might be all that is needed, possibly including prescribing ac. hydrochlor. dil. and ascorbic acid, in certain cases, and a check made after a further two weeks therapy. If there is no improvement on this advice and no obvious defect in the intake, or if the iron prescribed is unacceptable to the patient, then a course of intravenous iron would be given and the hæmoglobin level checked again 2 weeks later. An unfavourable response would indicate that there is a fault in iron utilization and that a blood-film should be studied. If the pathognomonic changes of megaloblastic anæmia of

pregnancy are not present, the diagnosis of that disease can be established by examination of the sternal marrow.

Megaloblastic Anæmia of Pregnancy.—The incidence of this disease has been shown in recent years to be much higher than was previously thought. It was first described by Channing of Boston, U.S.A., in 1842 but it was not until comparatively recently that any large series has been published. Even so the collecting of cases published so recently as ten years ago took a much longer time than those within the last few years. For instance it took 17 years to collect 45 cases published in 1951, yet only 14 months to collect 90 cases in 1958: this accounts for the spectacular rise in incidence from 1 in 590 to 1 in 39 hospital confinements (or 2·8 per cent.). The increased prevalence, of course, is only apparent and results from a closer watch being kept for the patient whose hæmoglobin level is either very low or fails to respond to adequate iron therapy.

Hæmatological and Clinical Features

Hæmatological Features. The hæmoglobin level of patients with megaloblastic anæmia of pregnancy is very seldom above 65 per cent. and the lower the level the more likely it is that this type of anæmia exists, rather than pure iron deficiency, although the latter commonly is present as well. The ordinary blood-film seldom shows evidence of macrocytic anæmia though occasionally megaloblasts are seen and sometimes nucleated red cells in severe cases. It is on the marrow picture that the diagnosis is almost always made, though when there is doubt even here the response to folic acid in lowering the raised serum-iron level is final evidence in favour of the diagnosis. The reticulocyte response too is pronounced within 5 to 10 days of beginning folic acid treatment.

The Bone Marrow.—A sternal marrow puncture is only a minor procedure, and is done painlessly under local analgæsia, in the out-patient department. In well established cases of megaloblastic anæmia the marrow film shows very numerous megaloblasts of differing maturity, though in some only the transitional type seems to be present. Occasionally marrow puncture about the 30th week has shown a normal picture, yet a few weeks later a repeat puncture after iron therapy has failed, reveals a magaloblastic change, pointing to the tendency for megaloblastic anæmia to become more pronounced nearer term.

The resemblance of the marrow picture in many cases of megaloblastic anæmia of pregnancy to pernicious anæmia is very striking and can often only be excluded by finding free HCl in the gastric

juice or by an unfailing response to folic acid therapy and no recurrence after pregnancy is over. Because pregnancy normally tends to reduce gastric acidity the mere finding of achlorhydria in a macrocytic anæmia in pregnancy would not mean that the patient had pernicious anæmia but would indicate the need for caution in therapy (folic acid is contra-indicated in pernicious anæmia) and for a close follow up after pregnancy is over.

Clinical Features.—A disturbing feature of the disease is that the patient does not always look anæmic, even though the hæmoglobin level may be below 60 per cent. There is often a complaint of easy fatigue and of anorexia, or nausea and even vomiting. Diarrhœa is occasionally present and as the reverse is the more usual in pregnancy, it might well indicate the need for further blood study; soreness of the tongue and mouth would be viewed similarly. The spleen is not infrequently enlarged.

The disease seems almost invariably to appear after the 28th week of pregnancy, and by far the largest numbers are found after the 34th week. Multiparæ in their third or fourth pregnancies especially seem very prone to develop it; the incidence is relatively high in multiple pregnancy. There is no evidence that it is a familial disease, but there is a tendency for it to recur in successive pregnancies.

Possibly the commonest clinical feature is failure by the patient to respond to iron therapy. If a patient who has been taking iron by mouth regularly is found by 28th-30th week to have a hæmoglobin level below 65 per cent. a course of intravenous iron would be given and the hæmoglobin checked two weeks later. If the hæmoglobin has not risen by 10 per cent. marrow puncture is indicated.

Ætiology.—Because the disease clears up entirely *after* pregnancy, it is obviously brought about by changes that take place *during* pregnancy. Diet has been fully studied and the conclusion reached that it must play a part, but not the entire role. Poor diet especially as regards meat, was found in no less than 42 per cent. of one series of cases of megaloblastic anæmia of pregnancy, compared with 12 per cent. in patients with iron deficiency anæmia and 4 per cent. of normal controls. From this it would seem that it is a deficiency disease, that is, either a diet deficient in folic acid, or the demand for folic acid outstrips the supply as in multiple pregnancy, or there is defective absorption of the vitamin from the gut, or there is resistance to its action after absorption.

Against diet being wholly responsible is the fact that megaloblastic anæmia is found in patients who have had a completely sufficient diet; but failure to absorb could still be the reason, yet even this has been disproven by investigations.

Finally, interference in the action of folic acid once it has been absorbed by preventing its being converted into folinic acid could be the reason, especially as the folic acid level itself in the newly born is invariably high, even in patients with megaloblastic anæmia of pregnancy. Such factors as seasonal incidence, occupation, geographical distribution and other intercurrent complications have all been investigated, but have not been found to play a part in the incidence of the disease.

Comparison with other Macrocytic Anæmias in Pregnancy

Addisonian Anæmia.—In this country this is the most likely form of macrocytic anæmia that might be confused with megaloblastic anæmia of pregnancy. Age is usually a help for it usually occurs in older women. The blood and marrow pictures can be identical and although the finding of free HCl in the gastric juice would exclude Addisonian anæmia, achlorhydria in pregnancy would not make it even a probable diagnosis. Microbiological assay of the serum vitamin B₁₂ level could be helpful. But usually the most common way in which Addisonian anæmia is excluded from the diagnosis is in the clinical response to folic acid and the lowering of the raised serum-iron level. The hæmoglobin level too will rise and the marrow picture become normoblastic again. The final proof against Addisonian anæmia is that the megaloblastic anæmia of pregnancy clears up after pregnancy and needs no further treatment, whereas with Addisonian anæmia treatment with vitamin B₁₂ would need to be continued.

Steatorrhœa.—This produces a macrocytic anæmia through interference with absorption of the anti-anæmia principle by the intestine. The diagnosis would be made by noting the characteristic fatty stool and by the laboratory finding of a high fat content in the fæces.

Tropical Macrocytic Anæmia.—Such anæmias do not differ from those occurring in temperate climates, except that they are found more commonly in the tropics. They result from the diet being often very deficient (especially in meat which contains the extrinsic factor) from indigenous disease such as sprue (a failure of the intestine to absorb the anti-anæmic principle through enteritis resulting from a diet rich in carbohydrate and poor in animal protein) and from megaloblastic anæmia of pregnancy.

The classical blood picture is often obscured by the presence of more than one primary disorder or by severe iron deficiency, through dietetic defects and infestation with malaria, hookworm disease and the like.

Treatment.—The most commonly successful and therefore the most frequently used remedy against megaloblastic anæmia of pregnancy in

this country is folic acid. It is given by mouth or, if nausea or vomiting make this unsuitable, by injection in a daily dosage of 20 mg. A full course of iron therapy is usually given as well to make good the commonly associated iron deficiency. Ascorbic acid would probably be prescribed too.

Vitamin B₁₂ has been used successfully in some series, but usually only when dosage has been very high. Sometimes it seems both folic acid and vitamin B₁₂ are needed to bring about a satisfactory response. As might be expected there would be a problem if in addition to discovering megaloblastic anæmia in pregnancy, achlorhydria is found. In the absence of neurological signs there is no easy and certain way of being sure that it is not a case of Addisonian anæmia (uncommon though it is in pregnancy) to which the giving of folic acid alone is contra-indicated owing to the danger of causing neurological sequelæ. In such circumstances it is better to give either vitamin B₁₂ with folic acid, or liver by mouth until pregnancy is over, when the diagnosis will reveal itself.

Sickle-cell Anæmia.—This disorder is due to the presence in the patient's blood of an abnormal hæmoglobin, hæmoglobin S. Hemolysis occurs if the patient is subjected to anoxia, *e.g.* during a dental extraction, and there follows an acute fall in the red cell count accompanied by fever, abdominal pain and urobilinogenuria. Electrophoreses demonstrates the abnormal hæmoglobin. Treatment is by blood-transfusion. The patient is an African or West Indian, not necessarily pure-blooded.

HEART DISEASES IN PREGNANCY

Rheumatic carditis causes the vast majority of heart lesions found in pregnancy, and by far the commonest form the disease takes is mitral valvular disease. By comparison the aortic valve is involved only very rarely (2 per cent.) but when it is, is very commonly affected along with the mitral valve. Even so, the combined lesion is found only in about 13 per cent. of cases. Of the other less common lesions, congenital defects and hypertensive heart disease comprise the majority.

Although most patients will negotiate pregnancy and labour successfully when their management has been conducted efficiently, the added risk they run is shown by the fact that heart disease now occupies fourth place in the cause of maternal deaths.

In order to understand why there is such a risk to patients who have more than a minor cardiac lesion, it would be appropriate briefly to review the physiological changes that take place as a result of any

pregnancy to throw more work on the heart even when it is healthy. There is no hypertrophy of the heart muscle in pregnancy, the outwardly displaced apex beat of late pregnancy being caused by elevation of the diaphragm.

(1) It has been shown that from about the 12th week of pregnancy there is a gradually increasing cardiac output reaching a maximum at about the 28th week and there is a gradual decline until it becomes normal by term. After delivery the output suddenly rises and again gradually falls to normal. The chief reason for the increase in output is in order to deal with the rise in fluid volume of the blood which takes place in pregnancy and this has been estimated at 25 to 45 per cent. above the non-pregnant level.

(2) The gradually increasing pregnancy weight-gain by the patient.

(3) The limitation in excursion of the diaphragm removes to a variable extent the aid which this normally provides for the return of the blood to the heart.

(4) The new utero-placental vascular field through which the blood has to be circulated.

(5) The stresses of labour and lactation and the care of the child.

All of these additional items of work can be managed readily in the normal patient, because the cardiac reserve power is adequate. The test of this reserve power is to be found in the response of the heart to effort. If it is normal the symptoms produced will also be normal and in keeping with the effort. If disease has caused the cardiac reserve to be small, then symptoms will appear with minimal effort and in the worst cases even at rest.

The dangers of heart disease in pregnancy are directly related to its severity, and this is revealed by certain clinical data :

I. *The cardiac reserve powers.*—This is usually obvious from the history—whether or not there is dyspnœa and how much the patient can do before it appears ; whether or not there has been an episode of unmistakable failure or cough with hæmoptysis. Patients can then be placed in certain categories regarding functional capacity as suggested by the American Heart Association (1945).

CLASS 1. No dyspnœa on ordinary activity even in pregnancy.

CLASS 2. (a) Slight dyspnœa with some limitation of ordinary activity.

(b) Moderate dyspnœa with considerable limitation of ordinary activity.

CLASS 3. Marked dyspnœa and restriction of ordinary activity but comfortable at rest.

CLASS 4. Dyspnœa even at rest—history of attacks of heart failure. The prognosis becomes worse with each succeeding class.

II. *The ability for full antenatal rest.* This not only often depends on the social status of the patient but too often on her willingness or otherwise to co-operate.

Good antenatal care will include :—

(a) Enough rest at home (10 to 12 hours at night and 2 hours horizontal rest in the afternoon) and provision of home-help and transport to and from hospital.

(b) Avoidance of respiratory infections—shunning people with obvious colds and stuffy places of entertainment like some cinemas, etc.

(c) The patient's going to bed if she gets a cold and sending for her doctor.

(d) Avoidance of anæmia by taking extra iron and having the hæmoglobin checked from time to time.

(e) Being admitted for prophylactic antenatal rest, sometimes for a fortnight or so at 28 to 30 weeks when the cardiac output is at its maximum, *but always for 2 to 4 weeks immediately-preceding delivery*, depending on the cardiac class of the patient. The prophylactic rest need not be full rest in bed but rather a "hotel existence" in hospital.

III. *Cardiac rhythm.*—Fibrillation is decidedly an unfavourable sign, yet with good medical supervision and reasonable cardiac reserve pregnancy need not be contra-indicated.

IV. *Evidence of pulmonary congestion.* This would be shown by dyspnœa especially at night and by hæmoptysis. Such patients are very liable to sudden attacks of acute pulmonary œdema. Valvotomy in many of these patients has proved life saving.

V. *Valve affected.* It is said that the addition of an aortic lesion does not matter, but in practice patients with aortic incompetence will sometimes fail suddenly, either in labour or soon after delivery. It is fortunate that the lesion is not commonly met in pregnancy.

VI. *Sub-acute bacterial endocarditis.* The possibility of this complication arising either spontaneously or after dental extraction should be continuously borne in mind. Blood cultures should be done if it is suspected. Treatment by penicillin in large dosage is usually effective.

Antenatal Care.—The aim should be at least to prevent the patient from slipping from one class down the cardiac scale to a worse one; better still is to get the patient into a more favourable cardiac class whenever it is possible. Such patients should never be booked for a confinement at home.

In early pregnancy a decision may need to be made when the patient is Class 2 (*a*) or worse, as to whether or not valvotomy is indicated, or if the lesion is unsuitable, termination of the pregnancy. The answer to these problems will be given by full discussion with the cardiologist. In bad risk cases, in which the pregnancy is to continue the patient may need to spend considerable time in hospital. Good risk patients will be supervised as out-patients and need be seen no more frequently than normal patients. If it is felt that a particular patient should be seen more frequently, she is no longer a good risk, and ought to be admitted. Advice about rest and the management of respiratory infections, as already outlined, should be given. A careful watch is kept for the appearance of symptoms or signs of lessening cardiac reserve. If a patient fails to keep an antenatal appointment an immediate enquiry as to the reason should be made.

Heart Failure.—The patient will be less distressed in a propped up position in bed. Reduction of oedema is brought about by restricting salt and fluid intake and by the use of diuretics. Digitalis is indicated in congestive heart failure, especially if there is fibrillation. In acute pulmonary oedema such measures as morphia and oxygen administration and venesection may be needed. Labour should never be induced except when the patient has improved as much as can be expected, and further deterioration is probable.

Mode of Delivery.—The aim should be an easy delivery and fortunately this usually happens. In the first stage sedative drugs should be used freely because pain causing tachycardia may be the starting point of failure. The second stage should be a short one and if this is proving not to be the case, then help must be given forthwith. Forceps delivery under pudendal block analgesia with, if necessary, the addition of skilfully given nitrous oxide and oxygen, avoids the harmful effects of prolonged expulsive efforts. Cyanosis must on no account be permitted and extra care taken against the inhalation of gastric contents.

The indications for Cæsarean section are the same as for a patient with a normal heart, except that here any labour that is expected to be at all difficult should be avoided altogether. But when there is no obstetric reason for it Cæsarean section should not be done. It is a mistake to think that by avoiding labour the risk is less. The hæmodynamic changes following delivery seem to be more pronounced and their effects less well tolerated after Cæsarean section than after an uncomplicated vaginal delivery.

Postnatal Care.—Even after an easy vaginal delivery heart failure can appear quite suddenly. It may occur in mitral stenosis, but is seen

relatively more commonly in aortic incompetence. The duration of rest in bed will depend on the severity of the cardiac lesion and how the patient has stood up to labour, but there should be no undue haste in getting any patient up who has a heart lesion. Adequate breathing and leg exercises in bed will achieve more in warding off the threat of embolism than early ambulation without the latter's added stress.

The patient will be encouraged to breast-feed her baby unless there is actual heart failure, but only if she intends to continue breast feeding after her return home.

If it has been decided, because of the severity of the heart lesion and its unsuitability for surgery, that the patient should have no further pregnancies, some authorities would advise abdominal sterilization during the puerperium, after the patient has fully recovered from the delivery, that is, 7 to 10 days later. It is an advantage too for her to have continued postpartum bed exercises.

Infective endocarditis may arise in the puerperium, and this should always be kept in mind if a patient with a cardiac lesion develops puerperal pyrexia and there is either no obvious cause or there is a poor response to antibiotics of standard dosage. Blood-cultures would help in making the diagnosis. Penicillin in large doses possibly aided by other antibiotics would be needed and treatment continued for several months.

Prognosis.—The effects of chronic rheumatic valvular lesions tend to be slowly progressive. In considering mitral stenosis, the commonest lesion of all, the narrowing of the valve lumen gradually becomes more pronounced, causing interference with emptying of the left auricle and the appearance of symptoms of diminished cardiac reserve. The effect pregnancy has on this already progressive condition has been shown by some published figures to increase the rate of progress towards failure. Equally, though, there are others who dispute this point, leaving this aspect of the problem unsatisfactorily answered until strictly comparable series in large enough numbers can be reviewed. Allied to the matter of prognosis too are such items as age of the patient, social status, parity, valves affected, size of the heart and cardiac rhythm. The difficulty in attempting accurately to assess the effect of one other feature will be readily understood. Questions which are not infrequently asked are whether or not a particular patient may be permitted to have a child and how many children is it safe to have? Of course, the answer is that it depends not only on the severity of the heart lesion and the response to effort, but also on whether or not the lesion could be improved by cardiac surgery. As a guiding principle it is usually wise to advise patients with a relatively mild lesion (Class 1 and 2(a)) to have no

more than two children, and those with a more serious lesion (Class 2(b) and 3) not more than one. Class 4 patients should never consider child birth and if pregnancy does occur, termination should be advised. But this principle is only a guide and each patient should be individually assessed, keeping in mind the important considerations already mentioned. This was as far as it was possible to go until cardiac surgery appeared on the scene. Now, although by no means all patients are suitable, every patient with symptoms should be fully investigated with a view to operative treatment—certainly if symptoms are severe enough for termination to be the alternative.

Congenital Heart Disease

The commonest congenital defect is a patent ductus arteriosus, the remaining defects being of about equal incidence. Apart from response to effort the most important consideration is cyanosis—patients without cyanosis doing far better than those who have it. In fact, if cyanosis is at all marked it is probably better to advise termination of the pregnancy if the lesion is not suitable for surgery. With coarctation of the aorta, because of hypertension and the added risk of cerebral hæmorrhage in labour, elective Cæsarean section is usually advised.

Cardiac Surgery

The commonest cardiac operation is mitral valvotomy but all the other valves have now come within the scope of surgery. The first successful mitral valve exploration was done in Britain by Sir Henry (then Mr.) Souttar at the London Hospital in 1926 but it was not in pregnancy. It is fortunate that the commonest form of heart disease in pregnancy is mitral stenosis and this very commonly is the only valve affected for it renders the condition eminently suitable for surgery if symptoms warrant it. The operation at the present day has an operative mortality of about 5 per cent., and a success rate of at least 70 per cent. Apart from initially poor results a small number of the cases show evidence of re-stenosis of the mitral valve in the first three post-operative years. The patient most suitable for mitral valvotomy is the one with mitral stenosis alone, and of a degree to cause severe symptoms—that is at least Class 2(b). Another indication would be the occurrence of increasing pulmonary venous congestion when the operation can be regarded as an emergency, if fatal pulmonary œdema is to be avoided.

Auricular fibrillation does not contra-indicate mitral valvotomy but the operation would not be done if mitral stenosis were accompanied by a severe aortic lesion.

Among congenital heart lesions, patent ductus arteriosus, coarctation of the aorta, Fallot's tetralogy and some septal defects have been operated on successfully, many with very good results.

PULMONARY TUBERCULOSIS AND PREGNANCY

There is good evidence to show that generally speaking pregnancy does not adversely influence the course of this disease. At the Black Notley Sanatorium Maternity Unit, of 618 patients who had either arrested, quiescent or active pulmonary disease, only 7.3 per cent. showed retrogression during or after pregnancy. This figure is exactly what would be found in women of the same age group who are not pregnant and under identical conditions.

There will be occasions, possibly, when a patient, the control of whose disease is in the balance, becomes pregnant and termination by the vaginal route may be considered necessary. Even so there is clear evidence to show that it is not the therapeutic abortion which is beneficial, but the extra rest and care which follow it. The pregnancy that is allowed to continue under the same ideal control shows exactly similar results. This emphasizes that in the majority of cases a good response in early active tuberculosis, whether in pregnancy or not, is largely dependent on the ability of the patient to take advantage of full medical management. Now that pulmonary tuberculosis is becoming increasingly controlled, there is no shortage of beds for tuberculous patients, and so there should be no difficulty in providing the care essential for pregnancy to continue under supervision.

The important point is to know that the patient *has* active or quiescent disease, so that proper treatment can be given in pregnancy. Those with active disease will have full rest, preferably in a sanatorium, and antibiotic therapy. Anti-tuberculous treatment by means of streptomycin and para-amino salicylic acid or isoniazid has no adverse effect on the foetus and may be used in pregnancy with confidence when indicated. Collapse therapy may be used and even the occasional major thoracic operation is not necessarily contra-indicated. Yet it is advisable, if possible, not to induce an artificial pneumothorax or to resort to thoracoscopy and division of adhesions within 6 weeks or so of term; major surgery too is usually better kept until after pregnancy. Patients with quiescent disease should be radiographed every 3 months and again a month after delivery. Exacerbation of the disease may occur in the puerperium, but this is thought to be due to the added effort of looking after the baby rather than to increased excursion of the diaphragm. Therefore everything possible should be done to relieve this strain by further convalescence and home-helps later. This is

not to say that patients with active or recently quiescent disease should be encouraged to become pregnant. On the contrary, they should be instructed to avoid conception until their chest condition has been quiescent for at least 2 years.

There seems little doubt that undiagnosed active pulmonary tuberculosis deteriorates markedly in pregnancy and in the puerperium, but it may not be more marked than in the non-pregnant state and under similar conditions. Nevertheless, the earlier the diagnosis, the earlier the treatment and the better the prognosis; to this end the chest of every pregnant woman should be examined radiographically as early in the pregnancy as is practicable. Several published series have shown the incidence of unsuspected pulmonary tuberculosis in pregnancy to lie between 0.2 and 0.5 per cent. The amount of radiation to the foetus from a single chest X-ray is of no significance. As well as providing the usual antenatal care, iron deficiency anæmia should be watched for and corrected. It would be more likely to be found in patients with a more chronic type of disease.

Management of Labour.—An easy labour should be the aim with adequate sedatives. If labour is expected to be in the least difficult, then delivery should be by Cæsarean section (and many of those patients who are resting completely and having a fattening diet too, tend to have large babies). If the first stage is unduly protracted, or if there is abnormal uterine action, again delivery should be by Cæsarean section. Similarly a prolonged second stage would be avoided by the timely and skilful use of forceps. The anæsthetic and the anæsthetist are, of course, important. Ether, although not absolutely contra-indicated, is usually better avoided and one of the other non-irritating forms of inhalation anæsthesia used instead. Spinal, extra-dural or local infiltration may be preferred in suitable cases. In the presence of tuberculous laryngitis, Cæsarean section is indicated, unless the delivery is taking place easily, because the strain of labour tends to produce œdema of the larynx.

Puerperium.—Extra care will be needed in the puerperium in watching for exacerbation of pulmonary signs. Prolonged rest in bed will be given to those with active disease and not until after the sputum has been proved negative would the patient be allowed contact with her baby. If the disease is open, the mother and baby, unfortunately, should be kept entirely apart. When segregation cannot be arranged the risk of infecting the baby can be greatly reduced if the mother is intelligent and follows her instructions in the use of a face mask diligently and is scrupulously careful in the matter of keeping and cleaning her feeding utensils separately.

Breast Feeding.—From the standpoint of the mother's disease, lactation would not be contra-indicated except in poorly responding active disease or when the patient becomes unduly exhausted by it. There is always serious danger of infection of the baby, except when the sputum does not contain tubercle bacilli; if there is the slightest doubt, breast feeding should be avoided.

When an infant develops tuberculosis it has almost always been infected through a close relation with open disease, in this case the mother. There have been relatively few recorded instances (5 only in Britain) of proven intra-uterine infection resulting in congenital tuberculosis, for the placenta normally offers an impassable barrier to the tubercle bacillus. But if a focus of infection develops in the placenta, fortunately a rare occurrence, there would be great danger of its eroding a foetal blood-vessel and causing disseminated disease in the foetus.

B.C.G. Vaccination of the Baby.—This has been proved to be a safe and effective way of producing immunization. It can be done in the first week of life and is recommended for the babies of mothers even with closed disease. Mantoux testing is done annually and the vaccine repeated should the test become negative.

Non-Pulmonary Tuberculosis in Pregnancy

New cases of non-pulmonary tuberculosis are being seen less and less now that pulmonary disease is being brought under so much better control. It is, therefore, not surprising that pregnancy is only rarely encountered in patients with extra-pulmonary lesions that require some form of active treatment.

Genital Tuberculosis.—The commonest site in the female genital tract is the Fallopian tube and after that the endometrium. Infertility, the natural result of interference with the transportation of the fertilized ovum has been shown to be due to genital tuberculosis in 5 per cent of the patients attending some infertility clinics. Occasionally tubal pregnancy occurs as a result, but in recent years normal pregnancy and labour have been reported in patients successfully treated by anti-tuberculous chemotherapy.

Bone and Joint Tuberculosis.—Pregnancy itself has not been found to have an adverse effect on the course of bone and joint tuberculosis, but problems may arise when active disease, in particular sites, needs plaster of Paris immobilization. When there is active spinal tuberculosis, not only would the increasing weight-gain throw a dangerously heavy strain on the weakened vertebral column, but any form of plaster jacket must allow for the ever enlarging uterus—a state of affairs that

is usually found impossible to deal with satisfactorily other than by termination of the pregnancy. When the disease is quiescent, the only real problem is whether or not the existing deformity would interfere seriously with, or be embarrassed by, the growing bulk of the pregnant uterus. If there is no such problem then pregnancy should be allowed to continue and the mode of delivery would be dictated by ordinary obstetric considerations.

Tuberculosis of the sacro-iliac joint encroaches rather more closely on the obstetric field. The sacro-iliac joints in labour are normally subjected to variable stresses and strains, and so it is usually felt to be prudent to avoid these stresses altogether by Cæsarean section if the joint is diseased, even though the disease be quiescent. With active disease termination of pregnancy is advisable. When the hip joint is involved the same considerations exist as were mentioned in regard to the spine and the management is similar.

Healed tuberculosis, whether it be of the spine or the lower limbs may have resulted in a deformity and if it occurred during the growing years, the pelvis, being subjected to irregular stresses, may develop unequally and finally become an asymmetrical pelvis. This indirect result of skeletal tuberculosis elsewhere may create problems in delivery in later years.

Tuberculosis of the other joints usually present no special problems.

Urinary Tuberculosis.—Pregnancy adds tremendously to the seriousness of this condition, almost the reverse of its effect on pulmonary tuberculosis.

The disease may reveal itself for the first time in pregnancy, or its previous existence may have been known. Such is the effect of pregnancy on active disease that if not already widespread it usually advances rapidly to invade the bladder and the opposite kidney.

In a known case the patient will be under supervision and full anti-tuberculous treatment and the question of terminating the pregnancy can be considered early. If one kidney has already been removed, it becomes more urgent still.

When renal tuberculosis is seen for the first time in pregnancy, it may masquerade as pyelitis, but ordinary treatment fails or relapse occurs quickly. Whenever pyelitis fails to respond to adequate treatment or recurs, tuberculosis should be considered as a possible diagnosis. Sterile pyuria is not always found for there may be secondary infection from coliform organisms. The diagnosis would be made by a full bacteriological study of the urine including guinea-pig inoculation and by intravenous pyelography and cystoscopy. Once the diagnosis is made, anti-tuberculous chemotherapy would be started, the pregnancy terminated and the course of the disease closely followed

so that if necessary nephrectomy could be carried out to prevent further spread. A patient who has been successfully treated for renal tuberculosis by chemotherapy and nephrectomy would be advised not to become pregnant for at least three years in order to be certain of cure. Permission to conceive would be given with more optimism if it is the left kidney which remains. She would run the same risk that any patient with one kidney runs in pregnancy—pyelitis affecting the sole remaining kidney. If this happened a prompt response to treatment would be hoped for ; if not the question of termination of pregnancy would arise and the matter of whether or not tuberculosis had recurred carefully investigated.

SUGAR IN THE URINE IN PREGNANCY

The testing of urine for sugar at the beginning of pregnancy and at intervals throughout is an important part of antenatal care. In this way unsuspected diabetes will not infrequently be discovered and will then be brought under treatment to the great benefit of both patient and foetus.

There is no doubt that pregnancy will occasionally cause diabetes to appear in a patient who earlier in pregnancy was found to have no glycosuria. It is for this reason that the urine should be tested for sugar, not only at the beginning of pregnancy, but at least monthly, and if it is found, further investigation made to find out its significance.

Glycosuria in Pregnancy.—Sugar found in the urine in pregnancy may arise from one of the following conditions:—

- (1) Diminished glucose tolerance.
- (2) Lowered renal threshold.
- (3) Diabetes mellitus.
- (4) Lactosuria.

Procedure.—The discovery of a reducing substance in the urine demands finding out whether or not it is sugar and if so whether or not it is glucose. If it is glucose the cause has to be looked for amongst those listed above. The modern way of testing urine for sugar is by the small *clinitest* method. If this is positive *clinistix* papers are used to find out if the sugar is glucose. The *clinistix* papers are impregnated with a mixture of glucose oxidase and peroxidase and ortho-tolidine. If glucose is present it reacts with glucose oxidase to form gluconic acid and hydrogen peroxide. The latter acting on orthotolidine gives a blue colour in the presence of peroxidase. If it is not glucose the possibility of its being lactose arises.

Lactosuria.—This is only found occasionally near term, but is quite common during lactation. The *clinitix* paper will give a negative reaction and if final proof of the type of sugar is required, the osazone test would reveal it.

Diminished Glucose Tolerance.—Glucose being present in the urine, the glucose tolerance test would be done. Normally after ingestion of 50 g. of glucose the blood-sugar will not reach 0.18 g. per cent. (which is the level of the renal threshold for sugar) and no sugar will appear in the urine. But when there is intolerance, it will rise above the renal threshold, hence glycosuria will be found, due to : -

(a) An abnormally accelerated absorption from the alimentary tract—alimentary glycosuria. The blood-sugar rises rapidly to above normal, but falls again equally rapidly.

(b) The curiously specific “pregnancy effect” on carbohydrate metabolism. This is thought to be connected with the dominant role played by the anterior pituitary during pregnancy, resulting in easy mobilization of glucose from the liver, and, in some degree, in anti-insulin activity. This causes the sugar tolerance curve to assume a plateau appearance, as it rises above normal and sugar appears in the urine, but the curve then flattens out and is back to normal limits within $2\frac{1}{2}$ hours. A response such as this does not necessarily mean a patient will develop diabetes. On the contrary, the majority of cases of sugar intolerance return to normal after pregnancy is over ; nevertheless, in some it will later take on true diabetic features, especially if there is already a family history of diabetes mellitus.

Lowered Renal Threshold. Proof that this is the reason for glucose being present in the urine is shown by the sugar tolerance test—sugar appearing in the urine when the blood-sugar is well below the normal non-pregnancy renal threshold level (0.18 g. per cent.), and, of course, the sugar tolerance test being otherwise normal when there is no other abnormal condition present. Lowering of the renal sugar threshold occurs quite commonly in pregnancy and is thought to be due to interference with resorption of glucose by the renal tubules. It is only a temporary state, and function returns to normal after the pregnancy. Being a common condition in pregnancy, it will sometimes accompany the other causes of glycosuria, diminished sugar tolerance and diabetes mellitus, and the elucidation can be brought about only by the sugar tolerance test. As would be expected, a lowered renal threshold for sugar can make the management of true diabetes more difficult.

Diabetes Mellitus. Before 1923 when insulin was isolated and became available for treating diabetes mellitus, diabetic patients seldom become pregnant because the severity of the disease, unchecked by treatment, often caused amenorrhœa (hence the low fertility of most pre-insulin diabetics). It was fortunate that diabetics did not easily become pregnant in those days because pregnancy enormously increased the risk they ran. Not only did the patient herself stand a 30 to 40 per cent. chance of dying, but the foetus stood a far greater one, 40 to 50 per cent., even in those patients who themselves survived.

After 1923 when Graham treated the first diabetic patient in Britain with insulin, there was naturally a spectacular change in prognosis for diabetics, especially for those who became pregnant, and many more did under the influence of insulin. In 1933 Skipper published a review of 118 pregnant diabetic patients treated at The London Hospital over the preceeding ten post-insulin years. The maternal mortality had fallen to about 10 per cent., but the foetal loss showed a disappointing persistence in remaining at about the same pre-insulin figure of 40 to 50 per cent. Since then there has been a gradual improvement in the outlook for both mother and child, yet that for the child has lagged sadly behind, for although the maternal mortality has been reduced to less than 2 per cent., that of the foetus is still 15 to 20 per cent. in spite of full medical and obstetric care.

Pre-diabetes mellitus. Recently attention has been drawn to the significant obstetric histories of women during the few years immediately preceding the onset of established diabetes mellitus. The history will often be one of either unexplained intra-uterine death of the foetus or the birth of an abnormally large baby which may or may not have survived. Although the blood-sugar level of such patients need not be abnormal, nor the ordinary sugar tolerance curve diabetic in type, their babies at autopsy often show the hypertrophic changes in the pancreas, characteristic of the babies born of true diabetics.

The care of a patient suffering from diabetes mellitus who becomes pregnant should be undertaken by both diabetic and obstetric units. The object is to keep the diabetes as well controlled as it is possible safely to do, and to deliver the foetus before it dies *in utero*. In order to make sure that wide fluctuations in the blood-sugar level do not take place, it is often advisable to have the blood-sugar estimated frequently throughout one day on several occasions from mid-pregnancy onwards. This would be especially indicated if glycosuria became increased or ketonuria appeared. Although it is known that very commonly pregnancy temporarily aggravates the diabetes, increasing the need for more insulin, the problem is often complicated by a lowering of the renal threshold for sugar. Near mid-pregnancy the insulin should be

changed to the soluble kind, partly so that the more frequent injections of the soluble insulin will meet the needs more uniformly, and partly so that the sudden diminution in the insulin requirements after delivery can be met quickly. For this change-over, the patient is admitted to hospital for a few days—for “stabilization” (re-adjustment of dietetic and insulin requirements). The obstetric care of the diabetic calls for a close watch for the complications which are known to be more common in diabetes and for a decision on the time and form of delivery.

Complications. There is an increased incidence of pre-eclamptic toxæmia, hydramnios, foetal abnormalities and of foetal death. Added to these, of course, are ketosis and hypoglycæmia.

The finding of toxæmia or of hydramnios, especially the former, in a diabetic is associated with an increased risk to the foetus. If hydramnios makes palpation of the foetus difficult, especially its head, then a radiograph should be taken to exclude gross foetal abnormality. This is particularly important when a decision is being made about the time and mode of delivery, especially when Cæsarean section is being considered. Should ketosis appear at any time during pregnancy the risk to the foetus is increased.

The child may be lost in a diabetic by dying *in utero*, and this happens more commonly during the last 3 weeks of pregnancy. The cause is unknown, but it is just as liable to happen in mild cases requiring no insulin treatment as in severe. This is the reason for the modern practice of delivering all diabetics between the 36th and 37th weeks.

The child may also be lost in labour. Before it was the policy to deliver diabetics early, the enormous size of the foetus causing difficult labour accounted for a certain proportion of foetal deaths, but it is a common fact that the foetus in a diabetic stands up to labour uncertainly, especially if the labour is protracted. For this reason most primigravid diabetics, especially if they are not young, should be delivered by Cæsarean section. It might be justifiable to try surgical induction of premature labour in a multipara.

Finally, the child is especially prone to die within the first 24 hours of delivery. For this to happen to an infant of such huge dimensions (even at 36 weeks) seems incongruous, but even though it is big the infant is flabby and has poor birth vigour. The cause of death is not always clear, but atelectasis and hyaline membrane disease are commonly found post-mortem and are probably related to prematurity.

Evidence is growing that the outlook for the foetus is improved a good deal by admitting diabetics to hospital for a month or so before delivery for antenatal rest and closer control of their diabetes. It is hardly necessary to say that because of the need for specialized care of both mother and baby, diabetics, even the most mild cases, should be

delivered in a hospital suitably equipped for Cæsarean section, for the care of the premature infant and with laboratory facilities.

Diabetic vulvitis.—The patient may complain of soreness and irritation of the vulva before it is known she has diabetes. Diabetic vulvitis has a characteristically florid appearance; the whole vulva is blotchy pinkish red and swollen with the rash fading upwards to the mons veneris and outward to the thighs. It is due to monilial infection and it is always associated with monilial vaginitis. The diagnosis is confirmed by finding the mycelia of the fungus on microscopical examination.

It is treated by controlling the diabetes and by the use locally of nystatin vaginal pessaries and vulval cream. The curdy white debris is first removed from the vagina by gentle swabbing with a sodium bicarbonate solution before the pessary treatment is begun.

Management.—Mention has already been made of some of the special needs in the antenatal care of the diabetic. As well as taking the usual safeguards, special watch should be kept for ketosis. If it is found, the patient should be admitted to hospital forthwith. The same is true for toxæmia. There is no justification for treating diabetics in pregnancy with hormones (œstrogen and progestogen) as advocated by White for reducing the foetal mortality. Clinical investigation in this country does not confirm the initial good reports.

Time of delivery.—When pregnancy is otherwise uncomplicated delivery about the 36th week is favoured by the majority of obstetricians, although some choose a week later. In the presence of toxæmia, definite hydramnios or evidence that the foetus is abnormally large, delivery would have to be considered earlier, bearing in mind the dangers which increasing prematurity carries, and the need for excluding gross foetal abnormality by X-rays if palpation is difficult.

Mode of Delivery. Postpartum Care of Mother and Baby.—Some of the reasons for favouring Cæsarean section rather than vaginal delivery have already been given. As well as being safer for the foetus, Cæsarean section, being a planned operation, is a better-managed form of delivery for the mother who can be given a calculated amount of glucose to cover the requisite dose of insulin for a known degree of diabetes. The delivery too can usually be planned to coincide with the ready attendance of pædiatric and laboratory personnel if need be. The same cannot be said for labour with all its uncertainty. However, certain multiparæ may well be treated by induction of labour, Cæsarean section being done when labour does not follow the induction.

There are two especially important points in preparing a diabetic for operation.

(1) The pre-operative glucose should never be given into the stomach, but intravenously, because aspiration into the lungs from regurgitation during anæsthesia can cause fatal pulmonary œdema.

(2) Ether should never be given to a diabetic in any circumstances. A spinal, paravertebral block or a skilfully given general anæsthetic are the alternatives to local infiltration analgesia, which is an especially satisfactory method in all but the unco-operative patient.

The demand for insulin falls off soon after delivery and frequent blood-sugar estimations will be needed until the level again becomes stable.

The Infant.—It is a wise precaution to keep the infant, large as it often is, in an incubator for the first 48 hours because of the liability to attacks of cyanosis and to hyaline membrane disease. Oxygen is then ready to hand, the humidity can be kept at about 80 per cent. and the temperature at 90° F. Because some of these babies have an excessive amount hydrochloric acid in their stomachs, some authorities advocate gastric and pharyngeal aspiration soon after delivery, and at intervals for the first 48 hours to prevent regurgitation and inhalation. If this is not done, then the head of the cot should be kept low.

The babies of diabetic mothers are œdematous and lose weight rapidly, but because of the increased tissue fluid they do not need to be given fluids (or food) for the first 2 days. There is no tendency to hypoglycæmia.

Finally the babies, in spite of their size, are premature, and need to be treated with gentleness. They, like their mothers, are also prone to infection.

ACUTE SPECIFIC FEVERS

Measles.—Morbili in pregnancy is uncommon because most adults have had it in childhood and are relatively immune. In severe cases abortion or premature labour is likely to follow. Intra-uterine transmission of the disease to the foetus has been observed, and the child may be born with the characteristic rash, or the rash may appear during the puerperium. It is especially dangerous to a young infant on account of risk of bronchopneumonia. Whether or not measles contracted by the mother can cause developmental defects in the foetus is not known with certainty. One published series gives an incidence of 16 per cent.

German Measles.—The significance of the association of rubella in the mother and congenital defects in the infant was first brought to notice in 1941 by Gregg and since then many other series of cases have been published.

It is a serious complication to arise in pregnancy because no matter what is felt about the true incidence of defects, there must always be anxiety until the baby is born unaffected. The incidence of abnormalities seems to vary from country to country and also with each epidemic the highest being reported from Australia - up to 90 per cent. - whilst in other countries it is less than 5 per cent. In this country the risk is placed at about 30 per cent.

The effect of German measles in causing defects is very much stronger if it is contracted in the first 4 months of pregnancy than later, and the organs affected too seem to vary according to the month, the eye and the ear being particularly susceptible in the 1st and 2nd months respectively.

In the prevention of infection during pregnancy it is important that pregnant women should avoid contact with any known case of rubella. If a patient has already the disease there will probably be some immunity but reliance cannot be placed on this. Therefore, if a pregnant woman in the first 4 months of pregnancy has been in contact with rubella, a temporary passive immunity should be aimed at by giving an intra-muscular injection of 750 mg. of gamma-globulin within 8 days of contact.

If German measles is contracted in the early months of pregnancy what is to be done? The legal position at present in this country would not allow therapeutic abortion on the grounds of risk to the foetus. Nor might the risk be so serious as is imagined: and it is advisable to bear in mind that the virulence of the infection varies greatly, in some cases producing an incidence of defects only a little above average.

Typhoid Fever.—Typhoid fever is a serious complication of pregnancy in that abortion or premature labour occurs in a very large proportion of the cases; but the pregnancy does not affect the disease. The bacilli have been demonstrated within the organs of the foetus, and ulceration of Peyer's patches may also be found in the foetal intestine. The still-birth rate is high.

Small-Pox.—The prognosis of small-pox during pregnancy is more serious than in the non-pregnant state, the confluent and hæmorrhagic varieties being commoner. The effect upon the pregnancy very commonly is to cause abortion or premature labour. Children have been born with the eruption. The possibility of transmission from mother to foetus of the protective influence of vaccination is disputed; but, when necessary, pregnant women may be vaccinated without any risk of inducing abortion or premature labour.

Chicken-Pox.—Varicella runs a similar course in pregnant and non-pregnant women. There is no increased liability to premature labour. The child may be born covered with the rash. Whether or not chicken pox can cause congenital defects is uncertain, and although in one series the incidence was found to be 11·5 per cent., the risk is thought to be small.

Scarlet Fever.—There is a definite connexion between puerperal sepsis and some cases of tonsillitis and scarlet fever. The most virulent organism found in association with puerperal sepsis (the hæmolytic streptococcus, Group A) is common to these three conditions. Care must be taken not to confuse the rash which occurs in cases of puerperal sepsis with that of scarlet fever. If the fever occurs during pregnancy the disease is more serious, especially if it arises towards the end of pregnancy. Abortion is likely to follow during the early months. There is no satisfactory evidence that the fœtus may be born with the disease, nor is there any evidence that it causes congenital defects.

Chorea.—True chorea gravidarum is a rare disease, which usually affects young primigravidae during the early months of pregnancy, although it occasionally recurs with successive pregnancies. It is characterized by choreiform movements and mental changes. Pathologically it represents a low grade encephalitis associated with a considerable element of neurosis. Although the latter factor is probably constitutional, it may be aggravated by emotional disturbances associated with the pregnancy, by fatigue, toxæmia or infection. The condition has to be differentiated from hysteria or pure neurosis; but in genuine cases there is a comparatively high maternal and fœtal mortality. The cause of death is either exhaustion or endocarditis. If there is a raised temperature the likelihood of endocarditis being the cause should be remembered and treatment arranged accordingly.

TREATMENT.—Absolute rest in bed and a liberal diet are necessary. The patient may need controlling owing to the severity of her movements. Although the association with acute rheumatism is doubtful, acetyl-salicylic acid and the salicylates are usually administered. The patient must be made to sleep, if necessary, with the aid of barbiturates. It is extremely important that she should be isolated and be reassured in every way. If there is any suspicion that the chorea has been induced by worry, an endeavour should be made to ascertain the cause of this, and if possible to remove it. The management and discipline exercised by a tactful nurse are most important

factors in the treatment. Corticotrophin (A.C.T.H.) has proved efficacious in controlling the disease; the infant born following this treatment is not abnormal.

The question as to the advisability of terminating the pregnancy has to be considered when the case is severe and the life of the patient is in danger. The mortality in these cases is high, and better results attend the spontaneous than the operative termination of the pregnancy.

Appendicitis.—The combination of appendicitis and pregnancy is not frequent, acute pyelitis being a much commoner concomitant of pregnancy. It is found more commonly in the first 6 months, and is comparatively rare after that time.

DIAGNOSIS.—Abdominal pains on the right side may be due to pyelitis, extra-uterine gestation, hæmorrhage into the corpus luteum, biliary or renal colic, or appendicitis; while in addition pain not so localized may be associated with the uterine contractions due to labour or miscarriage; the occurrence too of a small right sided retro-placental hæmatoma may simulate appendicitis. The most frequent error is to confuse pyelitis with appendicitis; in every case, therefore, the urine should be carefully examined.

Although the vomiting associated with appendicitis has been mistaken for hyperemesis gravidarum, its sudden onset and the condition of the pulse, temperature, and urine should make the diagnosis clear. Appendicitis during the early days of the puerperium has on occasions been confused with puerperal sepsis.

The danger of appendicitis during pregnancy and the puerperium is enhanced because it is more difficult to diagnose early and to drain the pelvis efficiently after operation. Miscarriage is also likely to occur.

The usual physical signs are somewhat altered when appendicitis complicates pregnancy. The cæcum, if freely movable, is pushed upwards and outwards by the enlarging uterus. The area of tenderness is at a higher level than usual and there may be little rigidity of the abdominal wall. The irritable state of the uterus whenever the peritoneum is irritated by the presence of infection or free blood is a valuable additional sign in doubtful cases.

Treatment.—The pregnancy should be ignored. If an operation is advisable, it should be performed in spite of the pregnancy. An adequate right paramedian incision should be made and the appendix sought well above the level of the iliac crest. It is usually advisable

to give antibiotic cover; morphia too will be needed in sufficient amounts to prevent the onset of labour. In a woman who has already had an attack, and is likely to become pregnant, appendicectomy is indicated as a prophylactic measure.

Chronic Nephritis.—The association of chronic nephritis with pregnancy may be a most serious complication. It is discussed in Chapter XVIII.

INTESTINAL OBSTRUCTION

The cause of this most commonly is a band resulting from adhesions following a previous operation. The condition leading up to the obstruction usually results from the altered anatomy brought about by the enlarging uterus. Other causes of obstruction are strangulated internal or external hernia, volvulus, intussusception and mesenteric thrombosis.

One of the great dangers of intestinal obstruction in pregnancy is the delay that often elapses before the correct diagnosis is made, the symptoms so often being attributed to the pregnancy. The classical symptoms, pain, vomiting and constipation, will be present, but the physical signs of tenderness and distension may be masked by the bulk of the enlarged uterus. A scar on the abdomen of a patient whose chief symptom is vomiting should always suggest the possibility of intestinal obstruction. Pyelitis, appendicitis, hyperemesis gravidarum, ureteric calculus and torsion of the pedicle of an ovarian tumour would all need to be considered in making a diagnosis. When the diagnosis has been made, laparotomy should be done with minimal delay. Salt and fluid replacement intravenously as a preliminary to operation could be the only reason for a temporary postponement. Needless to say a stomach tube would be passed in any case before operation for the twofold purpose of making anaesthesia safer and the operation less difficult. Laparotomy for the relief of obstruction, even without pregnancy, can be a very tedious operation; therefore, if the bulk of the uterus is such as seriously to interfere, it will have to be emptied by lower segment Cæsarean section before the obstruction is relieved.

ACUTE PANCREATITIS IN PREGNANCY

Acute pancreatitis presents no unusual features because of pregnancy; nor is it common in pregnancy, there being only about 50 reported cases, the vast majority of which occurred in the puerperium. Gall bladder disease is a frequent accompanying finding and may be the cause.

The most significant fact of acute pancreatitis in pregnancy is that the correct diagnosis is seldom made, largely because the possibility of the disease is not kept in mind. The most common symptom is epigastric pain and it is commonly accompanied by nausea and vomiting. Pain may, however, be situated elsewhere in the abdomen and may radiate to the back and to the shoulder.

The physical signs are variable too, but usually the patient is ill with mild or no pyrexia and dusky cyanosis of the face and neck. The abdomen is tender but there is no rigidity—an important diagnostic point.

Aids to diagnosis are the Lœwi mydriatic test and the Sahli salol test, but both are unreliable. Far more useful is the estimation of serum amylase but elevation may be present only for 24 hours. Usually the diagnosis is made at laparotomy. The conditions with which acute pancreatitis may be confused are other acute abdominal emergencies including intra-peritoneal hæmorrhage from ruptured tubal pregnancy. This is of little importance for the abdomen will be opened and the diagnosis made by finding brownish coloured free fluid and fat necroses in the omentum. A more serious error could result from a diagnosis of either hyperemesis gravidarum or toxæmic liver damage and conservative medical treatment continued for too long.

Treatment.—The treatment of this disease is still largely unsatisfactory. If the diagnosis can be made with certainty, which is unusual, laparotomy should be avoided and the patient treated symptomatically, with sedatives, attention to hydration and electrolytes and with antibiotics to prevent secondary infection. In the vast majority of cases laparotomy is necessary to establish the diagnosis with certainty. When this has been done the abdomen should be closed without drainage unless suppurative peritonitis already exists.

It is usually best to postpone the surgical treatment of any accompanying gall bladder disease unless the patient is fit and the disease justifies this additional operation.

GONORRHOEA

The disease may be contracted before, or during pregnancy, or at the time of conception. The presence of uncomplicated gonorrhœa does not appear to diminish the chance of conception, but gonococcal infection of both Fallopian tubes is likely to result in sterility.

The symptoms and signs of gonococcal infection are not modified by pregnancy. The point which requires emphasis is that at least 30 per cent. of women suffering from gonorrhœa have no symptoms.

When vaginal discharge is present it may well be due to associated trichomonal or monilial vaginitis, both of which are apt to be more severe and persistent in pregnant than in non-pregnant women.

The disease is unlikely to affect the pregnancy although, theoretically, the uterine cavity may become infected during the first 12 weeks and abortion may follow. If this occurs at all it must be rare. On the other hand, there is a grave risk during the puerperium that the disease may spread to the Fallopian tubes and pelvic peritoneum. During labour the child's eyes are in danger of being infected. Because of these serious risks if infection is suspected a full investigation is indicated. In diagnosis both microscopic smears and cultures are essential. They should be taken from both urethra and cervix. No reliance should be placed on the so-called "high vaginal swab" procedure. The complement fixation test for gonorrhœa has only limited value in the diagnosis of this disease. A weakly positive test may well be of no significance. A fully positive test is presumptive evidence of past or present infection. Its principal value is that it indicates the need for a careful search for the gonococcus.

Treatment.—The treatment of acute gonorrhœa during pregnancy does not differ from that which would be given to non-pregnant women.

Penicillin is the drug of choice and a single intramuscular injection of 600,000 units of procaine penicillin suffices for most cases. There is, however, evidence that strains of gonococci partially resistant to penicillin are becoming more common. After treatment smears and cultures should be repeated on the following day and then twice weekly. If the gonococcus is still present or reappears the remedy should be changed. Streptomycin may be given in doses of 1 gm. intramuscularly daily for 2 to 5 days. Tetracyclines by mouth are also effective but are seldom required. Douching is unnecessary, and indeed contraindicated, but local treatment may be indicated for the control of associated conditions such as trichomonal vaginitis or moniliasis.

Complications may need additional or alternative treatment. A Bartholin's abscess may be treated by aspiration, repeated if necessary, or by incision. Any surgical procedure should be accompanied by systemic treatment with appropriate antibiotics.

If gonorrhœa is first diagnosed when the patient is in labour, one million units of crystalline penicillin should be given at hourly intervals until delivery. During the early stages of the puerperium, the penicillin should be continued but in reduced dosage.

Sometimes gonorrhœa and syphilis are contracted simultaneously, and it is a disadvantage of treatment with penicillin that the signs of early syphilis may be suppressed, although the disease may not be

cured. If syphilis is suspected, streptomycin should be used in preference to penicillin. Serological tests for syphilis should be performed at the end of the observation period for gonorrhœa, and regularly during this observation if syphilitic infection is a considerable possibility.

Tests after Treatment.—Smears and cultures from the urethra and cervix should be taken on the day after treatment and thereafter twice weekly for the 1st month. During the 2nd month they should be taken once a week and then finally at the end of the 3rd month. A final test shortly before the expected time of delivery is a wise precaution.

Treatment of the Child's Eyes.—The time honoured preventive treatment with 1 per cent. silver nitrate solution instilled into each conjunctival sac is no longer popular because of the chemical conjunctivitis it causes. It has now been superseded by instilling into the child's eyes drops containing crystalline penicillin in concentration of 10,000 units per ml. This should be done at regular intervals, as, for instance, hourly for 12 hours. The child must be examined every day for signs of commencing ophthalmia neonatorum, which may cause blindness. If the signs become evident specimens of pus should be taken for identification of the organism. Without waiting for the result, treatment with penicillin should be started at once. Locally, crystalline penicillin, 10,000 units per ml. is instilled every minute until pus ceases to form, which may take 30 minutes or more. Thereafter instillations are continued at lengthening intervals. Penicillin may also be given by intramuscular injection. A single dose of 200,000 units of crystalline penicillin should be adequate.

SYPHILIS

Syphilis is an important cause of the premature interruption of pregnancy but, owing to the fall in incidence of syphilis, it is probably an uncommon factor in this country at the present time. When it is suspected the foetal tissues should be examined for the presence of *treponema pallidum* and both parents should be investigated, clinically and serologically. A woman who becomes infected during pregnancy or who becomes pregnant during the early stages of the disease, may show few or no signs. A woman who has given birth to a syphilitic child is herself syphilitic.

The effect of untreated syphilis upon pregnancy varies according to the lapse of time between infection and pregnancy and the treatment, if any, during pregnancy. Full treatment by modern methods will almost certainly protect the foetus, or perhaps cure it if it is already infected. The importance of the lapse of time is variable, but if the mother has syphilis during the pregnancy, the child is almost certain

to contract it too. If 5 or more years have elapsed between infection and pregnancy, the child is unlikely to be affected, even though the mother receives no treatment. Syphilitic infection of the foetus may result in abortion at any time from the 4th month of pregnancy onwards. There is some evidence that premature birth is a little more common among syphilitic than non-syphilitic babies. The double hazard of syphilis and prematurity is likely to cause the death of the child. Syphilitic babies born at term may have gross signs of infection or may appear to be normal. The more recent the infection in the mother the more likely is the disease to be manifest at birth. If the child is apparently healthy, it is very likely to develop some evidence of syphilis during the first year of life, but the evidence may be slight and it may be missed. The early signs include rashes of the skin, lesions of mucous membranes, enlargement of liver and spleen, and snuffles. The child with severe infection often wastes rapidly and is likely to be severely ill.

Serological tests for syphilis should be performed as a routine in the antenatal clinic. The results of these tests should not be regarded as absolute proof of the presence or absence of infection, for a negative test does not always exclude syphilis and, of course, subsequent infection may occur. Furthermore, the fact of a positive standard serological test for syphilis in a patient without history or signs of the disease does not always mean that the patient is suffering from syphilis. The result should be checked by repetition of the test, by the treponemal immobilization test, and by examination and testing of the husband.

Treatment.—Treatment should be adequate and should not be delayed. Penicillin is the drug of choice, and a low continuous level of the drug in the blood is more effective than a high concentration which is intermittent. Repository preparations which are absorbed from a deposit in the tissues are excellent for this purpose. Procaine penicillin is the standard remedy and it may be given in watery suspension, or in oily suspension to which is added 2 per cent. of aluminium monostearate. Either should be injected in doses of 600,000 units intramuscularly daily for 10 days and this is usually sufficient. Arsenicals and bismuth add no additional benefit in these cases and the former are dangerous. After treatment the mother should be observed and tested periodically. If she remains well clinically and the blood-tests do not become more strongly positive, no further treatment need be given. Clinical or serological relapse necessitates repetition of the treatment but the fact that blood-tests do not at once become negative does not. After delivery the mother should remain under skilled observation and in due course her cerebrospinal fluid should be tested.

It is common practice to repeat the course of treatment in subsequent pregnancies unless there is some contra-indication.

The fact that the cord blood, or the venous blood of an infant born of a syphilitic mother, shows negative serological tests for syphilis does not exclude infection. Furthermore, if the mother's serological tests are still positive, positive tests of the cord blood or venous blood do not necessarily mean that the infant has syphilis. In such a case, in the absence of clinical and radiological signs of syphilis, treatment should be withheld, and if the infant is not suffering from syphilis serological tests will become negative in a few weeks, or occasionally, in a few months.

If the infant is proved to be suffering from syphilis, there should be no further delay in treatment. Penicillin gives excellent results and other remedies are usually unnecessary. Dosage may be based on body-weight, and a good plan is to give 450,000 units per kilogram (200,000 units per pound) and to space the administration over 8 to 10 days. Injections may be given intramuscularly every 3 hours day and night, but missing one dose at night. Thus, for a child weighing 3.2 kg. (7 pounds) the total dosage would be 1.4 mega units and, assuming 10 days of treatment, the daily dosage 140,000 units and the individual dose 20,000 units. Alternatively, 150,000 units of procaine penicillin can be given intramuscularly each day for 10 days. Subsequent observation and tests should continue for many years, or at least until growth ceases. For full details of the management of these problems textbooks on venereology should be consulted.

EPILEPSY

Epilepsy has no significant effect on pregnancy, even in those patients in whom the fits are difficult to control. There is no tendency to abortion or premature labour. The effect of pregnancy on the epilepsy is extremely variable, and the final view is that there is just as good a chance of the disease being improved as there is for it to be unaffected or made temporarily worse. Exacerbation usually occurs in cases with generalized œdema or pre-eclamptic toxæmia. This fits in with the observation that epilepsy is often worse at menstruation, suggesting that fluid retention, due to an elevated œstrogen level, may well be the trigger mechanism in both cases.

In the management of epilepsy in pregnancy, therefore, an important point is played by restriction of sodium and fluid intake and keeping an even closer watch for the onset of toxæmia; regular weighing would make a useful contribution. Barbiturates and potassium bromide would be used as basic sedatives.

The chance of the progeny being affected when one parent has epilepsy has been rated as 1 in 10, and it is not uncommonly the first born, though 60 per cent. of the other children unaffected by the disease will have inherited the *tendency* to epilepsy.

DISSEMINATED SCLEROSIS

Opinions differ as to whether or not pregnancy adversely affects the course of this disease. The majority view at the present day, however, is that pregnancy has no effect and changes which occur in pregnancy would have taken place in any case. Discussion of the risks involved is often made difficult by the fact that in many instances the true diagnosis has not been disclosed to the patient and it is usually left to the husband to decide whether or not pregnancy should be embarked upon. If there is no interference with locomotion or with natural functions, special treatment during pregnancy is not necessary. Spinal and caudal analgesia should be avoided at delivery.

ANTERIOR POLIO-MYELITIS

Pregnancy does not increase the risk of contracting this disease, nor is the disease made more severe by the pregnancy, except perhaps to embarrass an already impeded respiration. There is some evidence now to show that, similarly to what is found in rubella, if the disease is contracted in the first 4 months of pregnancy there is an increased incidence of congenital defects in the foetus. Furthermore, when the disease occurs in late pregnancy there seems to be a decided risk of the infant's being born with poliomyelitis. The pregnancy needs no special management beyond that required for the treatment of the disease, and there is no tendency to abortion or premature labour. There is no reason why delivery should not be spontaneous. Cæsarean section would be called for if respiration is impeded. Volatile anæsthetics and spinal and caudal analgæsia are contra-indicated by the nature of the disease.

ADDISON'S DISEASE AND PREGNANCY

Addison's disease only very rarely complicates pregnancy ; approximately 60 cases have been reported in the literature. However, because replacement therapy has improved, the association may in the future be more commonly found ; but against this it could be argued that because tuberculosis of the adrenals is by far the commonest cause of Addison's disease the diminishing incidence of the former disease will cause a diminution in the incidence of the latter.

It presents much the same features in pregnancy as in the non-pregnant state, yet patients with typical crises or hypoglycaemic attacks are virtually never seen for the first time during pregnancy. The reason for this is not known except that pregnancy has a temporarily beneficial effect on the disease possibly due to the production of A.C.T.H. by the placenta. Support is given to this contention by the fact that relapse within a few days of delivery is common.

During pregnancy there is normally a great change in body-fluid distribution and blood-volume ; it is not, therefore, surprising that in Addison's disease these changes may become quite remarkable because of the absence of normal adrenal control ; in addition there will be gross electrolytic imbalance especially as regards sodium and potassium. Although it is unusual for a patient to be seen for the first time in a typical Addisonian crisis or in hypoglycaemia these complications can and do, quite commonly occur in known cases at various times in pregnancy and labour, but more particularly either in early pregnancy due to vomiting, or under the stress of labour, or early in the puerperium when fluid redistribution is taking place.

Prognosis.—Since cortisone has largely replaced other steroids in the treatment of the disease the outlook, and to some extent management, have changed a great deal. The mortality in pregnancy has been reduced from 35 per cent. in the years before 1930 to less than 10 per cent. at the present day. When D.O.C.A. only was available any form of operation, especially when requiring anaesthesia, had to be avoided because of the associated high mortality. With cortisone therapy the picture has been dramatically changed and major operations can be undertaken with confidence. It must be remembered that patients with Addison's disease do not tolerate morphia or allied compounds, which should never be given.

Treatment.—Although cortisone alone may ultimately prove itself quite effective in controlling Addison's disease it is still combined with a reduced dosage of D.O.C.A. and sodium chloride which appear to decrease the risks of hypoglycaemia and infection. During labour and immediately afterwards the dose of cortisone needs to be raised considerably from a maintenance pregnancy level of 12·5 to 25 mg. daily to about 200 mg. daily. Because of the fluctuating needs of adrenal replacement-therapy both in pregnancy, and more especially in labour and early puerperium, it is important not only that regular clinical assessment is made, but also that biochemical blood-assays are frequently carried out especially as regards sodium, potassium and sugar levels.

Lactation used almost invariably to fail before D.O.C.A. became available, but the outlook then improved. With cortisone there are more encouraging reports, but final conclusions have not yet been reached.

The Infant.—There is a high neonatal death rate the cause being uncertain. 17-ketosteroid excretion seems to be normal, but as gastrointestinal upsets occur it is felt that there is relative suprarenal deficiency especially as the adrenals commonly show cortical thinning.

Pregnancy after Bilateral Adrenalectomy. Now that the surgical treatment of Cushing's syndrome followed by cortisone replacement therapy is being used more often, and with success, anovulation and infertility are giving way to fertility; women so treated now become pregnant.

The investigations, observations and management follow the same basic principles as those mentioned for Addison's disease.

Acute Adreno-cortical Insufficiency

This dramatic complication may affect patients in one of the following groups:

(1) In patients with known hypocorticism—Addison's disease, adrenalectomy, prolonged cortisone therapy.

(2) On patients who previously have been normal. The latter group will be discussed. These patients fall into five fairly distinct categories;

(a) Idiopathic acute adrenal necrosis of pregnancy. Between the 20th week and term the patient is struck by sudden severe epigastric or crural pain and vomiting. There may be no shock. Tenderness is present in the epigastrium or in one or both loins, but there is usually no rigidity.

(b) Acute adrenal necrosis in association with shock and hæmorrhage. The associated conditions may be such as ruptured ectopic gestation, incompatible blood-transfusion or prolonged difficult labour. Epigastric or loin pain may be present, but more often this would be overshadowed by the accompanying condition.

(c) Acute adrenal necrosis in association with infection; commonly abortion occurs. Collapse appears suddenly and unexpectedly and may be accompanied by cyanosis and purpura.

(d) Acute adrenal necrosis in association with other serious complications of pregnancy, such conditions as severe vomiting of late pregnancy, eclampsia and accidental hæmorrhage.

(e) Acute adrenal necrosis in association with conditions incidental to pregnancy. It has been seen in hepatic necrosis in pregnancy which

brought about a generalized bleeding diathesis of which adrenal hæmorrhage was merely a part.

Acute adrenal necrosis in pregnancy is an extremely dangerous complication, most cases so far reported having proved fatal.

Clinical Features.—When epigastric or crural pain and vomiting suddenly develop leading to unresponsive hypotension, acute adrenal insufficiency will usually be considered early as a likely diagnosis. But the right diagnosis may not be so evident when the patient is already ill from infection, hæmorrhage, shock or other forms of stress. It is when the transient response only to noradrenaline with more sustained improvement to cortisone, the true nature of the condition is appreciated. Confirmation can be had by biochemical assay of electrolytes and by finding a rise in the eosinophil count. Other clinical features sometimes found are the good general appearance of a patient with serious hypotension and tachycardia; the absence of the usual purpura in this condition seems peculiar to pregnancy.

Management.—Intravenous noradrenaline has usually been given with only initial improvement. The immediate need is the substitution of hydro-cortisone and up to 300 mg. a day should be given but varied according to the clinical response. Later if there is a good response a change can be made to intramuscular or oral cortisone. As well as hydrocortisone there often is an urgent need for the correction of dehydration and electrolytic imbalance so that glucose saline is indicated as well. Hypocalcæmia, sometimes amounting to tetany may call for intravenous calcium therapy too. Accompanying oliguria is usually consequent upon prolonged hypotension, but, of course, may be the result of cortical renal damage as well and would then persist after the blood-pressure had been restored to normal. It should be managed according to the special needs of anuria.

Needless to say if the patient recovers, cortisone withdrawal must be gradual. In some cases recovery is complete; but when more acute cases have been successfully treated, some will be left with adrenal insufficiency when management should be along the lines for Addison's disease.

PHŒOCHROMOCYTOMA IN PREGNANCY

This is only a rare complication of pregnancy, but it is exceedingly dangerous; yet with closer vigilance not only will more cases be diagnosed but will be discovered early enough for treatment to be undertaken more effectively than heretofore.

Presentation.—The condition will most likely be mistaken for fulminating pre-eclamptic toxæmia because of headache, palpitations, vomiting, epigastric pain and hypertension. Albuminuria and œdema, however, are usually absent. Other symptoms may be sweating, nervousness, dyspnoea and substernal pain.

Characteristically the symptoms appear in attacks which are initiated by stress such as pain, exercise, emotional strain and minor operations; anæsthesia and operations seem particularly prone to cause an attack and many patients have died from so called shock following this event, the phæochromocytoma being discovered at post-mortem. In the same way the condition has mimicked obstetric shock, the patient failing to recover after a simple forceps delivery. The cause of symptoms is release into the circulation, usually suddenly, of excessive amounts of adrenaline and noradrenaline. This may happen spontaneously or as a result of compression of the tumour, particularly at operation for its removal.

Although the complication may arise in pregnancy and simulate severe toxæmia or concealed accidental hæmorrhage, it is just as likely to occur in the puerperium either soon after delivery as shock, or later when symptoms and signs may be less difficult to interpret.

Diagnosis.—It is usually not possible to palpate the tumour as it is often quite small; even pyelograms and peri-renal insufflation X-ray techniques will not always show a tumour.

The estimation of urinary adrenaline and noradrenaline (catecholamines) is obviously of great value, but the technique is not easy; recently an apparently reliable method has been described involving absorption of the catecholamines on precipitated aluminium hydroxide plus photofluorometric evaluation. Short of undertaking such estimations the diagnosis can often be presumed by provoking an attack with histamine or metacholine, which are specific in the presence of a phæochromocytoma, and then allaying the symptoms and signs with an adrenolytic drug, such as phentolamine.

Treatment.—This consists in removal of the tumour when the diagnosis has been made. If the diagnosis is made during pregnancy it is considered best to deliver by Cæsarean section when the foetus is sufficiently mature. The tumour is removed later.

A phæochromocytoma crisis can be controlled by giving intravenous phentolamine and could be used antenatally. Noradrenaline infusion is used at operation to counteract sudden hypotension as a result of removing the tumour.

THYROTOXICOSIS AND PREGNANCY

The association between thyrotoxicosis and pregnancy is only comparatively rarely seen because ovulation and menstruation are more usually suppressed in the established disease and infertility is the result. When the disease has been successfully treated a return of normal ovarian and uterine function can be expected in the majority of cases.

If the patient is pregnant her further management needs very considerable care. Thiouracil must never be used in pregnancy except for short intervals and then for the express purpose of rendering a patient fit for thyroidectomy because it passes the placental barrier and will depress foetal thyroid activity. Even though the baby may not have been made a cretin by its use in pregnancy, thiouracil may have effects on the developing thyroid which may come to light only in later years.

The treatment of thyrotoxicosis in pregnancy depends on its severity. In mild cases general medical care and the administration of sedative drugs may control the disease. If not, subtotal thyroidectomy is indicated. The patient is prepared for operation by a short course of iodine therapy. The results of operation are excellent and the risk no more than in the non-pregnant state.

Abortion is comparatively rare if the operation can be deferred till after the 16th week.

MYASTHENIA GRAVIS AND PREGNANCY

The cause of this disease is not known with certainty ; but the almost invariable improvement or cure resulting from removal of the thymus gland and by reproduction of the disease in experimental animals strongly suggest that it is due to dysfunction of the thymus. The theoretical explanation of myasthenia gravis is that an abnormal thymic secretion is produced that interferes with the formation of acetyl choline by the nerve cells at neuro-muscular junctions. The disease does not appear to affect pregnancy adversely and in the majority of cases improvement takes place, although this is variable ; but relapse commonly occurs within three weeks of delivery.

Myasthenia gravis has very rarely been found in the newly born ; usually the baby is healthy.

Patients suffering from myasthenia gravis pass through pregnancy satisfactorily if given neostigmine by mouth. It is never an indication for termination of pregnancy or for sterilization. After pregnancy the thymus can be removed and excellent results follow in at least 75 per cent. of cases.

CHAPTER XXV

MENTAL ILLNESS AND CHILDBIRTH

ALTHOUGH the period of child-bearing, including pregnancy, labour, the puerperium and lactation, can be considered as a normal physiological process, it is not surprising that, in a certain number of cases, the strain imposed may bring about symptoms of disease relating to the mental sphere no less than to the physical. In the past an attempt was made to correlate the form of the psychosis with the period of onset; the term "puerperal insanity" was introduced to describe a group of psychoses which followed childbirth and took the form of catatonic or stuporose states, whilst other puerperal cases had manic-depressive features.

At the present time, the tendency is to disregard the divisions formerly made and to take the view that a puerperal psychosis as a clinical entity does not exist. The main groups are affective disorders and schizophrenic psychoses.

The influence of child-bearing should be regarded as one of the many strains which are recognized as being capable of inducing mental illness.

Clinical Varieties.—The varieties most likely to be met with are :

- (1) Affective disorders.
- (2) The schizophrenic psychoses.
- (3) The toxi-confusional psychoses.

Toxic and exhaustive factors do not appear to play so important a part as was at first thought; but it has been noticed that there may be some mild confusion in the form of a distressed perplexity in a large number of cases in which the underlying psychosis is predominantly manic-depressive or schizophrenic. This confusional colouring sometimes appears when an organic illness, such as puerperal infection, occurs in the course of an existing psychosis. Therefore, while sepsis in the puerperium may increase the incidence of delirious states, it cannot be said that this reaction type is specific for psychosis developed during a puerperal infection.

As is commonly found in psychiatry, a certain amount of overlap occurs between the manic-depressive and delirious states as well as between the manic-depressive and paranoid reactions.

If the toxi-confusional symptoms are in the foreground, some authorities are inclined to regard their predominance as being of favourable prognostic significance and to prophesy complete recovery in such cases.

CAUSES

Various factors have been studied and there appears to be general agreement as to the importance of predisposing personality trends, environmental, social and economic conditions, or physical complications of the pregnancy, in so far as they are responsible for increased strain and psychological conditions connected with the patient's attitude to her husband, child, and home. Hereditary loading plays an important part.

At the psychological level, any conflict about childbirth may increase the mental strain and precipitate a psychotic reaction. In most cases gross psychological difficulties can be found; they may arise either from a deep-seated aversion to child-bearing or from an unsatisfactory domestic situation. During a period of war the absence of the husband from home appears to have been a particularly powerful influence in precipitating severe emotional distress in some cases.

The incidence of psychosis among women with puerperal sepsis is significantly small.

DIAGNOSIS

The common symptoms which forebode the onset of insanity are sleeplessness, depression, refusal of food, delusions of infidelity of the husband, and dislike of the child. The clinical diagnosis in each case is best left to the expert in psychiatry. Making full allowance for the fact that there may be a certain amount of organic confusional and depressive colouring in every case, he will be anxious to determine whether he is dealing with a true endogenous depression, a reactive depression dependent on current psychological difficulties, or a more paranoid picture denoting the early phase of a schizophrenic breakdown. Although paranoid features are relatively common in a considerable proportion of melancholic reactions, they are infrequent before the fourth decade. Delusions of hostility towards the husband or child are often expressed and may be regarded as reflecting a conflict about married life and motherhood.

PROGNOSIS

The general opinion among psychiatrists is that the prognosis of psychosis following childbirth is usually favourable. This is in keeping with the assumption that childbirth is a non-specific strain on the mental apparatus. The appearance of a psychotic manifestation

early in the pregnancy is indicative of a personality less capable of standing up to stress than one which remains free from signs of mental breakdown until the puerperium.

The prognosis in any individual case depends on a multiplicity of factors, including the type of the psychosis and the sum total of the constitutional and environmental influences. On occasion the prognosis is very poor.

TREATMENT

In by far the greater number of all cases of psychosis it is much better to remove the patient from her relatives and usual surroundings. If the patient is treated at home, it may be found that when she recovers, she has such an intense dislike of the surroundings associated with her illness that they may have to be changed permanently.

The patient should be given a suitable room or rooms, on the ground floor, with three attendants who have been trained in mental nursing, one for night duty and two for day duty, and the nurse on night duty must be able to obtain help promptly if required. If the rooms cannot be on the ground floor, means must be taken to prevent the patient being able to throw herself out of a window. Any possibility of suicide must be prevented, whether in the water-closet or bathroom; from scissors, knives, fire, light, or any other means. The only adequate arrangement involves the strictest and most constant supervision, and this must be impressed forcibly on all those in charge.

The most important points in active treatment are adequate nourishment, rest in bed during the acute stages, a due amount of sleep, and free action of the skin and bowels. Plain food should be given in abundance, supplemented by plenty of milk. If food is refused, and persuasion is useless, the patient must be fed nasally.

Pregnancy may very occasionally have to be terminated on account of insanity. This is especially the case when the patient has had two or more previous pregnancies and has become insane during the puerperium each time. In every case a psychiatrist should be consulted.

The majority of cases which arise after delivery develop during the first fortnight of the puerperium. In treating them the same principles should be borne in mind. When there is pyrexia, any possible source of sepsis must be eliminated and treated. Sponging may be used for hyperpyrexia, but in other cases the prolonged warm bath does more good. Incontinence of urine or fæces will call for the most careful nursing to prevent bedsores. When the insanity arises during the later periods of suckling, it is usually due to exhaustion, and for

this reason is commoner among the poorer classes. The patient should be removed from home and given abundant food, ample rest, and general tonic treatment in the hope that, when the strength of the body is regained, the mental condition also will be cured.

A cyclophrenic (manic-depressive) attack which has been precipitated by pregnancy, labour, the puerperium, or lactation responds well, as a rule, to electroplexy (électro-convulsant therapy). A course of ten electrically induced convulsions, given at the rate of two a week and well spaced, is usually required.

Marked improvement with vitamin therapy has been reported especially in those cases in which there were signs of exhaustion. The common practice is to give large doses of yeast or some preparation of vitamin B, by mouth, as well as 50 mg. of aneurin hydrochloride and 200 mg. of nicotinic acid daily, by injection. There is little doubt that the improved nutrition which results, especially when the appetite is artificially stimulated with 5 units of insulin two hours before each main meal, has much to do with the rate of recovery in some cases in which toxic confusional symptoms are uppermost.

Great importance is attached to environmental factors. This constitutes a major field of preventive treatment. Throughout antenatal care and treatment due attention should be given to the psychological condition of the pregnant woman and if necessary intensive psychological treatment should be carried out. As stated before, the psychological difficulties are usually easily discovered: unhappiness of married life, religious conflicts, absence of the husband from the home, illegitimacy, bigamous marriage, and extra-marital conception more or less exhaust the causes of psychological distress in the vast majority of cases. If this is kept in mind, much can be done by the general physician to reduce the proportion of psychotic reactions during pregnancy that are precipitated by psychological factors.

CHAPTER XXVI

MULTIPLE PREGNANCY

TWINS occur about once in 80 pregnancies, triplets about once in 6,000, quadruplets about once in 500,000, following Hellin's (1895) rule governing the mathematical frequency of plural birth, that is 80^1 , 80^2 , 80^3 and so on. Quintuplets are exceedingly rare, the famous Canadian quins being especially remarkable, in that they survived the risks of birth and infancy inherent in multiple pregnancy.

Multiple pregnancy may be an inherited tendency, as it is well known to occur more often in certain families. Statistics have shown that the frequency of paternal and maternal influence on twinning is about equal, and this applies to both binovular and uniovular twins. The faculty of uniovular twinning may presumably be inherent in either sex cell, but the production of two ova at the same time by the mother is difficult to explain as due to paternal influence. Nevertheless Stocks (1952) has shown that the frequency of twin births is maximal between the ages of 35 and 40, especially when the twins are binovular, and that a woman who has already given birth to twins is ten times more likely to have another multiple pregnancy than one who has not previously had twins.

VARIETIES

Twins may be binovular or uniovular.

Binovular twins are developed from two ova, arising in a single Graafian follicle, or from two follicles which may or may not be in the same ovary.

This variety of twins is three times as common as the uniovular variety. The children may be of the same or different sex, and are not more alike than is usual with members of the same family. As they are developed from separate ova, they have separate and distinct placentæ; sometimes the placentæ are loosely joined at their margins, but there is never any anastomosis between their blood-vessels. Each foetus has its own amnion and chorion, so that four layers of membranes are to be found where they are in contact (Fig. 86).

Uniovular twins are developed from a single ovum, which after fertilization, has undergone complete division to form two embryos. It is possible that such an ovum may contain two nuclei, or separation may occur in the early stages of segmentation, or two germinal areas

may be formed in one blastodermic vesicle. When a single germinal area becomes incompletely divided, some form of double monster results. Many varieties of conjoined twins have been described; they may be joined in the region of the sternum, or by the pelvis, or by the head.

Uniovular twins are always of the same sex, and are often remarkably alike in their physical and mental characters. Presumably the arrangement of genes in the chromosomes is identical, and inherited characteristics such as blood-grouping are necessarily the same.

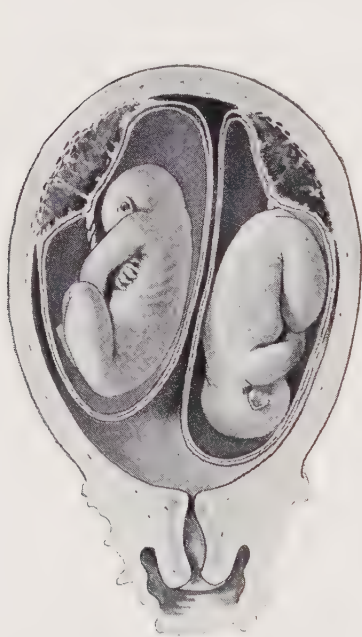


FIG. 86.—BINOVULAR TWINS.

The placentaë are separate and each foetus has its own chorion and amnion.

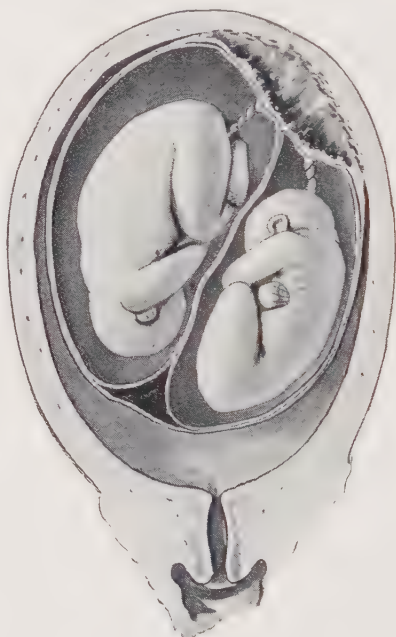


FIG. 87.—UNIOVULAR TWINS.

One placenta, two amnions and one chorion.

Uniovular twins have a single large placenta and a single chorion (Fig. 87). As a rule, the amniotic sacs are separate, but occasionally the two foetuses are contained in a single amniotic sac, originating as a common amnion, or resulting from the breakdown of the thin amniotic partition between the two foetuses. The umbilical cords are usually separate, but the foetal circulations always communicate by anastomoses in the placenta.

The communication between the two circulations in uniovular twins may cause unequal development of the foetuses, and sometimes

foetal death. Very occasionally one foetus will perish early in pregnancy and be retained *in utero* until term, becoming compressed and mummified, when it is known as a *foetus compressus* or *foetus papyraceus*. The more frequent occurrence of hydramnios with uniovular twins is undoubtedly related to the common placental circulation.

Triplets may be developed from a single ovum, or from two or three ova. The placenta and membranes will be arranged in the same way as in twins, according to the manner in which development has taken place.

Quadruplets and quintuplets are similarly developed.

It is theoretically possible for two ova produced in one ovulatory cycle to be fertilized at two separate acts of coitus. This is called *superfætation*, but there is no reliable evidence that it has ever occurred in the human. *Superfecundation* is the fertilization of an ovum produced in a succeeding ovulatory cycle after pregnancy has begun, but there is even less human evidence for this.

DIAGNOSIS

During pregnancy the presence of twins should be suspected from various symptoms and signs. All the symptoms of pregnancy, whether troublesome or not, may be exaggerated. Thus the nausea and sickness of the early months may be more pronounced. If the patient has already borne children she will often note an unusual rate of abdominal enlargement or complain of excessive foetal movements. Towards the end of pregnancy the patient is more likely to suffer from anæmia and calcium shortage. The prophylaxis is to ensure an adequate diet and to prescribe additional iron and possibly calcium as well. It is especially important too, to check the hæmoglobin level in the later weeks of pregnancy to avoid overlooking, not only iron deficiency anæmia but also unsuspected megaloblastic anæmia which is more common in multiple pregnancy. She is more likely to develop toxæmia of pregnancy. The tendency to œdema, varicose veins of the legs and hæmorrhoids is greater and the patient may state that she easily tires and becomes short of breath, and she may suffer undue discomfort owing to the large size of the uterus.

In multiple pregnancy the uterus at term is larger than would be expected for the period of amenorrhœa, and the girth, as measured at the umbilicus, may be several inches greater than would be expected at that period of the pregnancy. Hydramnios may also add to the enlargement and is more frequent with uniovular twins.

Undue enlargement of the uterus should always arouse suspicion, and the diagnosis is simple if two foetal heads can be felt. Both backs

and both breeches may be identified and an unusual number of small parts may be felt (Figs. 88 and 89). The diagnosis is made more certain by hearing two foetal hearts, recognized as two by their points of maximal intensity being at different positions, the sounds being lost between them, and the rates, counted at the same time, differing by at least 10 beats a minute. When both hearts can be heard in one

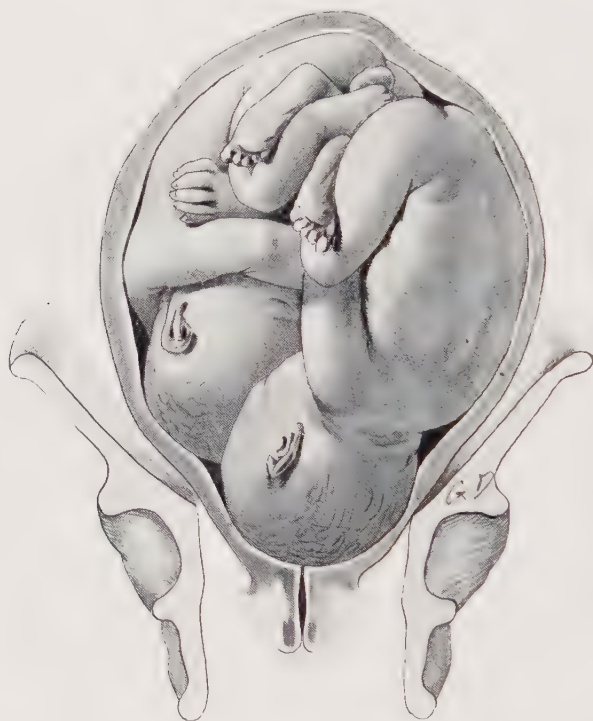


FIG. 88.—TWIN PREGNANCY. BOTH PRESENTING BY THE VERTEX.

Foetuses lying alongside one another. Both heads could probably be felt, one at the brim and the other above it in the iliac fossa. One back and an unusual number of small foetal parts would be recognized and possibly two breeches in the fundus.

area, they will be found to synchronize intermittently. Hydramnios makes the diagnosis of twins by palpation and auscultation extremely difficult. An X-ray should always be advised when twins are suspected and the patient's consent written in the notes. Radiological examination not only confirms the diagnosis but might also show evidence of gross abnormality or of conjunction, and so provide a warning of difficulty with vaginal delivery.

The diagnosis of twins is sometimes missed until the birth of the first twin. The high position of the fundus, palpation of a second foetus, and the presence of a second bag of membranes and presenting part then make the diagnosis clear.

Malpresentations are more common with twins. In about 40 per cent. of cases both present by the head: in about 35 per cent. one

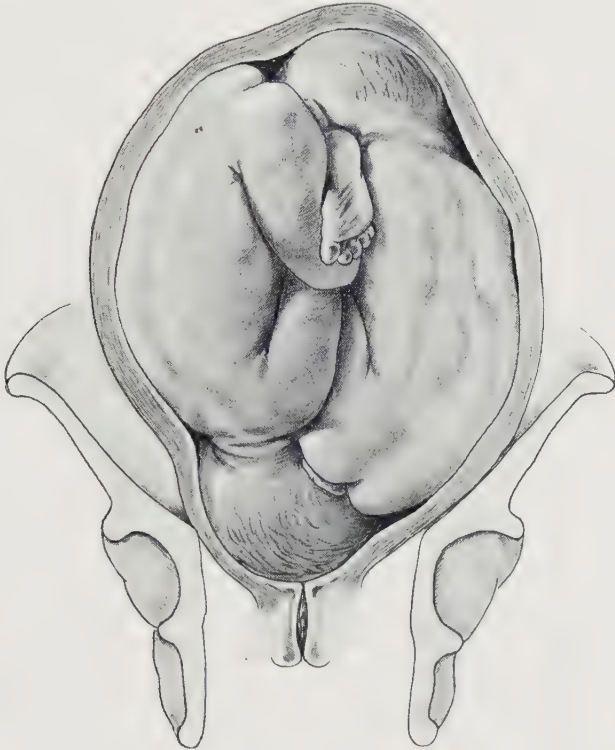


FIG. 89.—TWIN PREGNANCY.

First presenting by the vertex, second by the breech: foetuses lying alongside one another. This offers the easiest diagnosis. One head would be felt at the brim and one at the fundus; two backs with the small parts in the groove between would be palpable and two points of maximal intensity of the foetal heart-sounds could be made out, one on the right and below the umbilicus and the other on the left and above.

foetus presents by the head and one by the breech: in about 10 per cent. both present by the breech, and in about 15 per cent. a transverse lie is associated with either a vertex, a breech or a second transverse lie. The second twin may undergo spontaneous version during or after the birth of the first. It is said to be rare for both to be transverse.

PROGNOSIS

The risk to the mother is increased by the following factors :—

1. Greater tendency to toxæmia and eclampsia.
2. Abnormalities of labour.
3. Danger of postpartum hæmorrhage.
4. Possible increased risk of sepsis if labour is complicated, or if severe bleeding occurs.

The prognosis for the babies is decidedly worse in multiple than in single births, about 35 per cent. being stillborn or dying soon after delivery.

1. Prematurity is the greatest risk that all twins run, not only during birth but during the neonatal period too.

2. Complications of labour, such as malpresentations, placenta prævia and prolapsed cord are more common, and one twin may interfere with the descent of the other. The second twin may also be endangered by retraction of the uterus and premature separation of the placenta.

3. Death *in utero* affecting one or both twins may be caused by placental insufficiency associated with toxæmia, or from accidental interruption of the circulation.

MANAGEMENT OF PREGNANCY

The duration of twin pregnancy is very variable, it tends to be short. Indeed, in one study concerning several hundred twin pregnancies only 53 per cent. reached the 36th week, and in another it was observed that 10 per cent. ended before the 34th week. The time to expect the majority of twin pregnancies to end, therefore, is somewhere between the 34th and 36th week.

The added care that should be given to the patient with a twin pregnancy results from the greater frequency of certain complications.

Pre-eclamptic toxæmia is found at least three times as commonly as in single pregnancy, yet on balance it seems to run a much less severe course. Even eclampsia holds a much lower risk for both mother and baby. This is not to say that everything possible should not be done to try to prevent it. The fact that prematurity is the most serious complication for the baby in both conditions should be enough to guarantee constant vigilance for the onset of toxæmia in multiple pregnancy.

Anæmia.—Iron deficiency anæmia is common in ordinary pregnancy. The demand made by two or more foetuses makes hypochromic

anæmia much more common; it is, therefore, essential to prescribe additional iron, and frequently to check the hæmoglobin level from mid-pregnancy onwards. Defective absorption can then be made good in ample time by parenteral iron therapy. Again, if intravenous iron therapy does not produce the expected improvement in the hæmoglobin level, sternal marrow puncture would be indicated to detect the unsuspected presence of megaloblastic anæmia of pregnancy. In this form of anæmia the patient often does not look anæmic, even though the hæmoglobin level may be quite low. It is commoner too in multiple pregnancy. The treatment is discussed in Chapter XXIV. With the object of attempting to raise the foetal prothombin level (known to be low in the premature infant) synthetic vitamin K. 10 mg. daily I.M. is given to the mother whilst she is in hospital.

Hydramnios.—The incidence of this in multiple pregnancy is a good deal higher than with single pregnancy, and is commoner in uniovular twins. The upper rather than the lower sac is usually involved; toxæmia is more common when it is present.

Antepartum Hæmorrhage.—Although this complication could well be expected to be common, its incidence is only slightly increased underlining the benign course that toxæmia usually runs in multiple pregnancy. It would be natural too, to anticipate finding placenta previa more frequently because of the increased bulk of the placenta, even with uniovular twins.

The antenatal care then of a patient with twins should be intensified in order that toxæmia, anæmia, hydramnios, antepartum hæmorrhage and premature labour can either be avoided or discovered and treated. To this end the patient should be seen more frequently than usual from mid-pregnancy onwards. But seeing a patient frequently commonly means a comparatively tedious journey in the later weeks of twin pregnancy and the benefit gained on the one hand may be lost on the other. It is fortunate, therefore that it is now accepted practice to admit patients with more than one foetus to hospitals for rest in bed from about the 32nd to 36th week. In this way, not only is the tendency to premature labour, at a time when it is most likely to occur, circumvented, but the closest possible supervision of the patient maintained without causing her added stress.

After 36 weeks only those patients whose condition is wholly satisfactory are permitted to leave hospital. Those who have hydramnios are usually so uncomfortable that they are content to remain for the week or so longer that pregnancy is likely to last.

The following figures from a unit where this policy has been followed for the past 8 years are presented.

MULTIPLE PREGNANCY

	<i>Without rest</i>	<i>With rest</i>
Number of cases (76)	23	53
Incidence of toxæmia	52 per cent.	44 per cent.
Average duration of pregnancy	37 weeks	38 weeks
Average birth weight	5 lb. 7 oz.	5 lb. 9 oz.
Incidence of post-partum hæmorrhage	35 per cent.	18 per cent.
Combined stillbirth and neonatal death rate	11 per cent.	5 per cent.
Maternal mortality	0	0

MANAGEMENT OF LABOUR

The duration of twin labour need not be expected to be longer because the uterus is overdistended. On the contrary, even when hydramnios co-exists, labour with twins is not necessarily lengthened. Nevertheless, labour is apt to be complicated and the babies premature making delivery in hospital essential. Because of this the delivery team should include an obstetrician and an anæsthetist, both with experience, and cross matched blood should be nearby. The complications particularly associated with twin labour are postpartum hæmorrhage, malpresentation, prolapse of the cord and premature separation of the placenta, the latter three all more commonly affecting the second twin. Labour is premature; therefore, the safeguards concerning such labours must be taken. Depending on the expected degree of prematurity, incubators will be made ready for care of the babies after delivery. The delivery of the first twin is usually no different from normal labour, but two steps are important--(1) Prophylactic periniotomy under local analgesia is done to safeguard the fragile head. (2) the umbilical cord is divided between two clamps: this is essential in uniovular twin delivery to prevent bleeding from the undelivered fœtus. Occasionally with binovular twins the placenta of the first now follows, but it is far more common for both placenta to be expelled after the second fœtus.

The Second Twin. With the first fœtus delivered and transferred to another's care, the next step is to find out the lie and presentation of the second. This is done by abdominal palpation, but a vaginal examination is made too, in order to make sure the second cord has not prolapsed. Transverse or oblique lie will be corrected by external or internal version and the head or breech guided into the pelvis. The fœtal heart is now auscultated almost continuously and a close watch kept for bleeding; an increase in the fœtal heart-rate, or bleeding, indicates the need for expediting delivery. But what is the purpose of delaying delivery of the second fœtus at all in the face of the constant risk of

mounting anoxia from increasing placental separation? There are two considerations bearing on the answer to this question. First, because uterine activity normally ceases for a variable interval after the first child is born, and, because postpartum hæmorrhage is much commoner in twin labour, it is logical to wait for the uterus to become fully active again before preparing to deliver the second child. Secondly, as it has been reliably shown that the greatest risk to the foetus is prematurity and as there is convincing evidence that assisted delivery is equally hazardous, spontaneous delivery with every care should be the aim unless there are strong indications for assistance.

If no danger signs appear, how long should the waiting be? As soon as contractions return and the presenting part is engaged the membranes may be ruptured artificially and the safety of the cord again confirmed. It is difficult to say, dogmatically, when contractions do not return quickly, how long the waiting interval should be; but as the normal delay has been shown in a large number of cases to be 30 minutes or less, the membranes should not be ruptured until that time at least has elapsed.

The Third Stage.—Postpartum hæmorrhage is the chief danger to the mother in twin labour, probably because of the overdistended uterus and the large placental site and it is because of this that delivery in hospital is essential. Cross matched blood should be on hand for every twin labour, but the dangers of postpartum hæmorrhage have been reduced considerably by injecting 0.05 mg. of ergometrine intramuscularly with the birth of the anterior shoulder of the second twin.

Locked Twins.—The importance of this complication has more in its dramatic appeal than in the frequency of its occurrence. It is indeed rare, its incidence being assessed at 1 in 1000 twin labours. Although it is seen so uncommonly it is remarkably dangerous to the foetus, usually the leading one. It is most commonly found in primiparous twin labour; other ætiological factors, which may be important, are deficient liquor in the second sac, a large pelvis, or small babies.

The commonest and most dangerous situation is when the first presents as a breech and the second as a vertex. The chin of the after-coming ahead of the first is caught above the fore-coming chin of the second, and if disengagement is not effected quickly the delay ends fatally for the first. In these circumstances the after-coming head of the first twin should be decapitated in order to free and deliver the second, the decapitated head being delivered by fundal pressure or forceps later. The other forms of locking, are less common and occasionally heads are merely in collision at the brim.

The principle of treatment in twin locking is disengagement when possible and assisted delivery ; when not possible and both fœtuses are still within the uterus and one or both alive, Cæsarean section would have a place. Whenever there is unexplained delay in the second stage in twin labour some form of locking should be considered, and the



FIG. 90.—AFTER-COMING HEAD OF THE FIRST LOCKED WITH THE FORE-COMING HEAD OF THE SECOND.

possibility of conjoined twins should not be forgotten. The X-ray taken in pregnancy may, on further study, be revealing, or it may be necessary to take another in labour. Examination under anæsthesia would be the final means of diagnosing locked twins. If the fœtuses are living and vaginal delivery does not appear possible or safe, Cæsarean section would probably be done.

CHAPTER XXVII

ABNORMAL UTERINE ACTION

WHILST our knowledge of the factors initiating and controlling uterine contractions remains incomplete, it is difficult to define and classify the different types of abnormal uterine action. This is reflected in the variety of the terms used, and the varied interpretation of these terms by different authors. Before discussing the abnormal, it is essential to consider the action of the uterus in normal labour divided into its three stages.

FIRST STAGE.—Dilatation is brought about by two completely different mechanisms; one active and the other passive, but both equally important. The active role is played by the upper uterine segment using three separate forms of muscle behaviour; contraction, retraction and relaxation. By contracting, the upper segment compresses the gestation sac containing the foetus raising the intra-uterine tension, from 5 to 10 mm. Hg. during the resting phase, to 50 mm. Hg. at the height of the contraction. As a result pressure will be directed towards the line of least resistance, that is towards the lower segment and cervix, and utilized to help in dilatation. Retraction by holding and making good much of the advance achieved by the preceding contraction has been called the "ratchet mechanism" and is considered important in achieving progressive dilatation. It is owing to retraction that the muscle fibres of the upper segment become increasingly shorter and thicker, causing thickening of the wall of the upper segment which contrasts markedly with the over-thinning wall of the lower segment.

It is natural that where the relatively thick upper segment meets the decidedly thinner lower segment, there will be a ledge or rim running round the inside of the uterus. This, of course, is the physiological retraction rim or ring, and is present in every normal labour. If there is obstruction to the expulsion of the foetus, this rim will become more obvious because the upper segment, working harder, will become thicker, whilst the lower segment becomes thinner; the result is the appearance of an exaggerated or pathological retraction rim called Bandl's ring, and is pathognomic of advanced obstructed labour. Relaxation of the upper segment between contractions is of the utmost importance, not only in avoiding muscle fatigue, but also in allowing the normal placental circulation to be resumed, which is an essential safeguard against increasing foetal anoxia.

The passive role is given to the lower uterine segment and cervix, but it is so necessary to dilatation that the term "co-ordinated relaxation" more fittingly describes the important part it plays in normal labour.

When the upper segment contracts the lower segment and cervix relax; this is referred to as *uterine polarity*. Playing this passive part the lower segment and cervix are pulled up and dilated over the presenting part of the foetus by the active contraction and retraction of the upper uterine segment. It is probable that the pressure of the presenting part of the foetus on the lower uterine segment and cervix, acting through a local reflex, stimulates the normal contractions of the upper segment during this stage of labour; it is certainly true that in cases in which the presenting part is not well applied to the lower segment and cervix, for example, in occipito-posterior position and disproportion, labour is often complicated by poor uterine action.

SECOND STAGE.—The stage of expulsion of the foetus. This is brought about by the powerful contraction and retraction of the upper uterine segment, assisted by the bearing-down efforts of the patient, resulting in contraction of the abdominal muscles and diaphragm and relaxation of the pelvic floor. These forces are stimulated by the pressure of the presenting part on the pelvic floor once it has escaped through the fully dilated cervix. This is the reason why the patient generally experiences a desire to bear down as soon as the second stage of labour begins.

THIRD STAGE.—The separation and expulsion of the placenta. Rhythmical contraction and retraction of the upper uterine segment cause separation of the placenta and its expulsion into the vagina.

There are no very definite standards of normal uterine action during labour, and the action can be judged clinically only by observing the strength and frequency of the contractions, and noting their effect on dilatation of the cervix and expulsion of the foetus.

More accurate methods of recording uterine contractions have been used to study abnormal action, and the effects of various drugs and anæsthetics upon the contractions:—

1. By a rubber bag inserted through the cervix into the lower segment but outside the membranes. This bag is filled with water and connected by rubber tubing with a mercury manometer, and the variations in pressure recorded on a slowly moving drum.

2. Tokography. An apparatus is applied to the mother's abdomen which will respond to changes in the shape of the uterus occurring during contractions. The variations may either be recorded direct by an arm writing on a moving strip of paper, or the apparatus may be

modified to make the recordings electrically when it is known as a tokodynamometer.

3. By inserting a fine polythene tube through the abdominal and uterine walls direct into the amniotic sac, and recording the changes of pressure inside the uterus by means of a specially sensitive oscillograph.

4. Electro-hysterography—the measurements of changes in electrical potential as a result of uterine contractions.

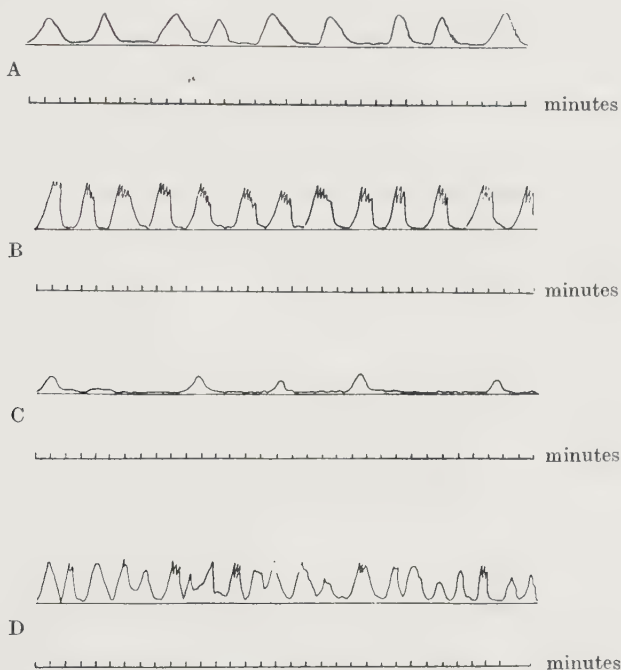


FIG. 91 —GRAPHIC RECORDS OF UTERINE ACTION.

A.—Uterine contractions in normal 1st stage.

B.—Uterine contractions reinforced by bearing down efforts in normal 2nd stage.

C.—Infrequent contractions in uterine inertia.

D.—Colicky action of the uterus with occasional bearing down efforts before the cervix is fully dilated.

The records obtained by these methods show bearing-down efforts accompanying second stage contractions, and superimposed lines due to coughing, vomiting, and even foetal movements are easily recognized.

Recent experimental work, particularly with tokodynamometers placed on different parts of the uterus to make simultaneous records of the uterine contractions, has thrown considerable light on uterine activity.

The following characteristics in the action of uterine muscle have been demonstrated during normal labour.

1. During a contraction the fundus of the uterus contracts more quickly, forcibly, and for a longer period than the rest of the uterus. The middle zone contracts more slowly, less forcibly, and for a shorter period than the fundus, whilst the lower segment and cervix remain in a passive state of low tone and do not contract.

This is known as the gradient pattern of contractility with fundal dominance characteristic of normal labour.

2. A contraction begins simultaneously at two points on either side of the uterus, in the region of the site of entry of the Fallopian tubes. From these two points contractions spread medially and downwards to fuse in the midline, passing down as one contraction in the middle zone.

It has also been demonstrated that the normal contractions of the uterus during pregnancy, prior to the onset of labour, differ from those described above in that the whole of the uterus including the lower segment and cervix contract at about the same intensity. This non-gradient pattern of contractility without fundal dominance occurs in false labour, and is sometimes seen in cases of primary uterine inertia.

At the onset of normal labour uterine contractions occur at intervals of 15 to 20 minutes, increasing in frequency as the labour progresses, so that by the end of the first stage the contractions last for 60 to 90 seconds, and usually pain is felt after the uterus begins to contract, and passes off before the contraction has finished.

Classification of Abnormal Uterine Action

- (1) Abnormally weak action (normal polarity).
 - I. Primary uterine inertia.
 - II. Secondary uterine inertia (Uterine exhaustion).
- (2) Abnormally strong action (normal polarity).
 - I. No obstruction—precipitate labour.
 - II. Obstructed labour. Exaggerated upper and lower segment response.
- (3) Disorderly uterine action (abnormal polarity).
 - I. Inco-ordinate uterine action.
 - (a) Hypertonic lower segment.
 - (b) Localized tonic contraction (contraction ring).
 - (c) Generalized tonic contraction.
 - II. Cervical rigidity.

Before going on to describe the clinical aspects and management of the various kinds of abnormal uterine action, certain functions will be briefly examined to find out whether or not they have any bearing on the ætiology. It might be imagined that since so much has been learned from examining uterine function by instrumental recordings, management in labour would now be specific, simple and effective, but it must be confessed that progress has been disappointingly slow, especially in the application of this knowledge to the clinical field. The reason undoubtedly is that the problem is a complex one, concerned as it is, not only with uterine musculature of varying degrees of developmental imperfection, but also with such diverse factors as endocrine influence, somatic type, disproportion, parity, emotional tension and the rest. The solution is not made easier by the fact that the labour pattern of the different clinical types often merge one with the other. This might help to explain why some schools of thought hold such contrary views to others on whether or not the inco-ordinate uterus is in a state of hypertonus. Until such fundamental matters are agreed, progress is bound to be slow.

Parity.—The vast majority of cases of abnormal uterine action are found in primigravidæ; 96 per cent. being the figure in one series of cases. Whether or not it is due to unconditioned neuromuscular response or to emotional disturbances is not known, but probably the former has the more important place; it is not common for the unfavourable action in the first labour to be repeated in subsequent labours as long as the first labour has either ended in vaginal delivery or at least dilated the cervix well.

Age.—This is not nearly so important as it used to be thought, for although abnormal action is assuredly found more often in the elderly than in the young primigravida, it does occur at any age. It should not be forgotten that labour in a primigravida of 35, or more, years can be normal but should take place in hospital.

Maturity.—One of the reasons why concern is felt by some when pregnancy goes much beyond term is that labour tends to be difficult; not necessarily due to disproportion. One view is that the cause of the difficulty exists before labour begins, and is, in fact, the real reason why labour is deferred. Lack of polarity and failure in formation of the lower segment is felt to be the fundamental defect.

Uterine over-distension due to twins or hydramnios, has received exaggerated importance in the past for neither clinical observation nor instrumental recordings of the uterus in labour confirm the existence of weak action under these conditions. Nor do fibroids have any influence on function.

Psychological Influence. Experience shows that it is almost impossible to predict the particular pattern labour will take in any woman in her first labour. Even the most composed and emotionally well balanced patient may have the worst possible form of disorderly uterine action; and the reverse is true; the abnormally anxious, immature and unrelaxed patient going through the smoothest of labours. It may be that when the emotions are given complete freedom they have less tendency to cause tension in and around the lower segment than in those women who inhibit their feelings. The sponsors of natural childbirth with minimal pain declare that it is this fear which causes troublesome tension and hence pain and delay. Statistics, however, do not give support to this thesis for there is no significant reduction in the incidence of delayed labour in those patients who have practised relaxation exercises and have gone to instruction classes in pregnancy, over those who have done neither. This is emphasized by the results of labour in unmarried women in whom often neither antenatal preparation for labour is made nor a feeling of social security engendered.

At Queen Mary's Maternity Unit, Hampstead, prolonged labour (more than 48 hours) occurred in only three out of 120 labours in single girls ($2\frac{1}{2}$ per cent.) and forceps delivery once.

Developmental defects.—When fusion of the Mullerian ducts has been incomplete and more especially when development has been unequal leading to asymmetry, as in uterus unicornis, uterine dysfunction is more apt to occur. Defect too in the musculature leading to hernia-like sacculation in labour have been found in patients undergoing Cæsarean section for abnormal uterine action; the association is thought important.

Dystrophia Dystocia Type.—Although abnormal uterine action can occur in any woman, no matter what her physical appearance, a particular build does seem to be more prone to develop it. Patients in this group are thick-set, of small stature, short-necked, coarse skinned, obese and often have male distribution of pubic hair and an android pelvis.

Disproportion and Malpresentation.—An ill-fitting or high presenting part at term has been known for a long time to have a close association with inefficient uterine action. The failure of many a trial labour for disproportion has often been due to this factor alone preventing any real test of whether or not the head would have gone through the pelvis. In fact, as greater experience of trial labour is gained, it is soon realized that generally it is more a test of uterine function than of the fit of the head into the pelvis.

In breech labour too the breech with extended legs fits the lower segment well and behaves like a well flexed head in causing normal labour. The same cannot be said for the fully flexed or footling breech which is by no means well-fitting.

When the foetus lies transversely or obliquely, although the membranes may rupture early, it is common for the onset of labour itself to be greatly delayed. Occipito-posterior position of the head tending to favour deflexion and a less well-applied presenting part has become almost renowned for its particular type of ineffective and uncomfortable contractions, known as "posterior position pains". The position of the occiput would appear important in this particular case for it has been shown that oxytocin in the second stage is ineffective until the head has been rotated.

One important result of the behaviour of the uterus in cases of malposition is to emphasize the need for very careful examination of the patient whenever uterine action appears to be abnormal. It is well also to remember that too big a baby will often produce the same type of labour.

(1) Abnormally Weak Action (Normal Polarity)

(i) Primary Uterine Inertia.—The patient is almost always a primigravida and the contractions are weak, short lived and infrequent a faint shadow of normal labour. The uterine pattern of action and polarity are normal, the only abnormality being weakness. It usually affects labour from the start (hence the term primary) and may last throughout; but often, unless there has been premature rupture of the membranes, the character of the contractions improves when the waters break. Often too, contractions become normal only in the second and third stages. Progress naturally is in keeping with the strength of labour, so is bound to be slow. The condition of the patient physically is usually good for the pain is minimal, but her morale may deteriorate unless active efforts are made to support it. As long as the membranes are intact there is little danger to patient or foetus. If this ineffective action has been found to be the only obstetric abnormality, then the management will be that of primary uterine inertia.

(ii) Secondary Uterine Inertia (Uterine Exhaustion).—This is an uncommon condition now because the indications for avoiding it in managing labour are better understood. It is essentially uterine exhaustion or uterine muscle fatigue and, as the name implies, usually follows prolonged or excessively strong uterine action in the second stage of labour. It may thus reveal itself during the second stage or

become apparent only during the third stage. It is said that poor antenatal care, especially a diet deficient in first class protein, tends to favour this type of inadequate uterine function in the second and third stages, but there is no factual evidence for this observation. Almost always there has been excessive action of one or other form preceding it.

Another way in which serious uterine inactivity can be brought about is in the use of deep or prolonged anæsthesia. Ether has this effect but chloroform is even more potent in inhibiting uterine action. Clinically the condition is impending if the second stage contractions are beginning to grow weaker, and when it has been allowed to last too long or there has been lack of progress in spite of strong pains. A timely assisted delivery when this change is first noticed will avoid the appearance of the fully established condition.

Uterine exhaustion is present when the second stage contractions have finally disappeared and labour is at a standstill. It is probable that many cases of obstructed labour behave like this with alternating periods of excessive activity and rest before rupture of the uterus or aided delivery takes place.

In the third stage the completely flabby, inexcitable state of the uterus is characteristic and will give rise to delay in separation and expulsion of the placenta or to postpartum hæmorrhage from partial placental separation and a failure of uterine retraction.

(2) Abnormally Strong Action (Normal Polarity)

(i) No Obstruction—Precipitate Labour.—When the uterine contractions are very strong and follow one another rapidly, labour may be completed quickly, perhaps in a few minutes, and is then known as precipitate labour. The pattern of contractions and polarity are essentially normal, the only abnormal feature being their strength. It usually occurs in parous women, in whom the cervix dilates more easily, and resistance of the pelvic floor is slight. It is probable that in many of these cases dilatation of the cervix has been completed practically without any pain before the apparent onset of labour, and then a few strong second stage contractions complete the delivery. Once a patient has had a precipitate labour, even quicker deliveries are liable to occur in subsequent labours.

Apart from the mental upset of a very rapid labour which may catch the patient unawares, the main danger to the mother is from lacerations of the perineum and cervix. The child may be damaged by being born before the mother can lie down, and may sustain injuries to the head or the umbilical cord may be torn across leading to hæmorrhage.

(ii) **Obstructed Labour—Exaggerated upper and lower segment responses—Bandl's Ring.**—Here again the uterine action is basically normal both as regards the pattern of contractions and polarity. The upper segment actively contracts and retracts while the lower segment passively relaxes, but because there is obstruction to the passage of the foetus, the uterus in this case accepts the challenge and responds accordingly with powerful action. Because it is the normal task of the upper segment to expel the child and for the lower segment to relax, to receive and give passage to it, these particular characteristics appear in exaggerated form when there is obstruction. The upper segment, contracting almost incessantly and retracting, becomes hard and its walls very much thicker and shorter as it forces the foetus down and draws the lower segment and cervix up. As time goes on more and more of the foetus is driven down into the relaxing lower segment which, because of distension, becomes dangerously thin and will rupture if urgent help is not given. The clinical picture, thus, is one of a woman exhausted by pain and the demands of the overworking uterus, whose pulse-rate and possibly temperature are raised and whose upper abdomen is hard and the lower tender and distended. The line of junction between the two areas denoting the upper and lower segments, is clearly visible on the abdominal wall as an oblique groove or furrow. It is the retraction ring, which is present in every normal labour, but in this case because uterine action is exaggerated, it too will be exaggerated because of the over-thickening of the upper segment and over-thinning of the lower. Present in this exaggerated degree it is known as a pathological retraction ring or Bandl's ring. Because it marks the upper limit of the distending lower segment it will rise higher and higher in the abdomen, the more the lower segment is distended if this precarious situation is not relieved. As the fundus rises, the round ligaments become taut and stand out especially to palpation. The whole picture is an accentuation of labour in all its aspects and is a caricature of itself. It must not be thought that this picture of advanced obstructed labour would ever be awaited before help is given—it is needed long before.

(3) Disorderly Uterine Action (Abnormal Polarity)

(i) **Inco-ordinate Uterine Action.**—In this condition the uterine function is grossly deranged. There is an increase in muscle tone (hypertonia) especially in the lower segment, even at rest between contractions, and this keeps the intra-uterine tension continuously raised. The raised tension may be above the level of pain production, so that either the patient has continuous pain or discomfort, or it will

appear earlier than usual with a contraction and stay longer. This is not the only disadvantage; the raised intra-uterine pressure will, in the long run, bring about gradually increasing anoxia of the foetus whose signs of distress may call for urgent treatment by Cæsarean section in the first stage or by forceps delivery in the second.

(a) *Hypertonic Lower Uterine Segment*.—The increased tone in the lower segment in this condition brings about a reversal of uterine action; a weakly acting upper segment and a lower whose persistent hypertonus completely opposes it. Under such adverse conditions progress, if it is made at all, is distressingly slow. The increased tension makes the labour one of constant discomfort, the pain being felt chiefly in the back. It is this particular type of abnormal action which is often associated with a badly deflexed occipito-posterior position of the vertex giving rise to so-called “posterior position pains”. The reversed polarity of the uterus commonly seems to bring about a similar state of affairs in the gastro-intestinal tract for ileus often accompanies this long drawn out labour. Abdominal distension and vomiting occur and calls for constant attention to electrolyte balance. In cases which do not rapidly improve under the usual treatment of a Ryle’s tube and intravenous glucose Cæsarean section should be performed.

(b) *Localized Tonic Contraction (Contraction Ring)*.—This is an uncommon condition. Normal polarity is absent; the intra-uterine tension raised and contractions painful and purposeless. The term contraction ring dystocia means that an encircling band of muscle fibres is in a state of constant spasm which causes difficulty through narrowing the uterus to such a degree that local obstruction occurs. It may become evident in any of the stages of labour; in the first being associated with a long painful first stage; in the second and third stages causing delay. Theoretically the ring may arise in any part of the uterus, but is most commonly found in the lower segment at or near the site of the physiological retraction ring at the junction of upper and lower segments, or just above the internal os. It must be clearly understood that it is not causing obstruction in the first stage, because the cervix is not then fully dilated, and the stage of expulsion has not begun. It is the final pathological state of this particular type of deranged uterine action and it is the associated abnormal action which causes the prolonged labour. Although a contraction ring may be found in any stage of labour most difficulty in diagnosis arises when it occurs in the first stage of labour, so most attention should be given to that stage. When it occurs in the second and third stages its presence is often unexpected.

The diagnosis is made on clinical grounds for the contraction cannot be felt or seen abdominally; unless the cervix is sufficiently

dilated to allow intra-uterine palpation, a contraction ring in the first stage cannot be diagnosed by vaginal examination. Precise diagnosis is, therefore, usually impossible and the clinical picture is by no means always very different from other forms of disorderly uterine action. When it has been possible to locate the site of the ring, either at Cæsarean section or by internal palpation, it has been found most commonly as a constriction round the neck of the foetus although on occasions it has been found entirely below the head. Characteristically, it seems to form in the region of a natural groove of the foetus. Quite unlike Bandl's ring, which appears in an exaggeration of normal labour due to obstruction and heralds uterine rupture, contraction ring results from grossly abnormal action which is seldom effective enough to cause the cervix to dilate and never enough to cause rupture of the uterus.

(c). *Generalized Tonic Contraction*.—This condition is very rare now that the grossly unskilful and repeated attempts at delivery which in the past commonly caused it are so seldom encountered. The action is abnormal in that the whole uterus, both upper and lower segments, are in a state of sustained and powerful hypertonus; polarity is absent and the uterus moulds itself to the foetus.

Usually there had been repeatedly unsuccessful attempts at delivery; attempts to apply forceps before full dilatation, application of forceps outside the cervix, many attempts to rotate an occipito-posterior position or repeated attempts at internal version. The patient was exhausted both from these procedures and from the subsequent persistent pain of the tonically contracted uterus. The membranes of course, had long since ruptured and the foetus dead from anoxia resulting from sustained uterine contraction. As would be expected there was no danger of uterine rupture from this type of action because the lower segment was hypertonic too, and as the foetus was dead, urgent delivery was seldom called for. The past tense has been deliberately used to relegate this condition to the past when conditions in midwifery were often unfavourable. It is hoped that "active retention of the foetus" as the condition was graphically called, will remain only of historical interest.

(ii) **Cervical Rigidity**.—Only some cases of cervical dystocia should strictly be placed in the category of disorderly uterine actions but as all are due to faults at cervical level they have been included here. Accordingly, cases fall into the category of primary or secondary.

By primary cervical rigidity is meant that the internal os is unyielding through some anatomical or physiological defect and because

it does not relax together with the lower segment can be regarded as acting in a disorderly fashion. Polarity of uterine action is normal for the upper and lower segments, but not for the cervix. The first stage is prolonged, largely because the internal os is either extremely slow, or fails entirely, to dilate; but the contractions themselves are often abnormal too, either weak or inco-ordinate, due, it is thought, to a failure of the cervix to dilate.

Clinically the patient is a primipara and is not necessarily elderly. The first stage is prolonged, but the outstanding feature is the condition of the cervix. It is well taken up and closely applied to the engaged head, but it has an excessively firm rim and is unyielding, sometimes admitting no more than a finger-tip after many hours of labour. The lower segment is well formed and if only the cervix would dilate, delivery would proceed. It is in this type of labour that very occasionally a ring of cervix separates by necrosis from continuous pressure of the head.

Secondary cervical rigidity is caused by organic changes in the cervix resulting in fibrosis due to some previous obstetric injury or gynæcological operation.

The patient is usually parous and contractions are commonly of good quality. The firm unyielding cervix, because of scarring, may split if timely assistance is not given and the tear may extend into the lower segment. It is for this reason that any patient who has had a previous operation on the cervix should be in hospital for any subsequent delivery.

MANAGEMENT OF PROLONGED LABOUR

The management when labour is prolonged has a number of common basic requirements, no matter what is the particular type of abnormal uterine action.

Nursing.—The patient should be made as comfortable as possible. If the uterine action is weak she should be permitted to leave her bed in order to stimulate better uterine action. A fluid balance chart should be kept as well as temperature and pulse-rate records. The blood-pressure should be recorded at least twice daily, but more frequently in the presence of pre-eclamptic toxæmia. The urine should be tested at least 6 hourly for ketone bodies and, if vomiting is occurring, for urinary chlorides. In toxæmia, catheter specimens should be examined for increasing albuminuria. The foetal heart-rate and rhythm are recorded half-hourly in the first stage when the contractions are strong, or more often if changes have been noted. During the second stage recordings are made at 15 minute intervals.

When the membranes rupture, the foetal heart-rate should again be counted, the liquor amnii observed to see if it is stained with meconium.

The frequency, duration and character of the uterine contractions should be charted and notes should be kept of the physical and mental state of the patient.

Diet.—Patients in labour, even in normal labours, should never be given solid food, because if an anæsthetic is needed, it is less easy to empty the stomach of solid food than of fluid. When labour is prolonged the reasons for avoiding solid food are increased. In the first place the patient usually does not want it, secondly an anæsthetic is commonly needed at some time and, finally, solid food appears to promote ileus and initiate vomiting which leads more quickly to electrolytic imbalance and dehydration.

The fluid diet apart from providing all important fluids and some caloric requirements, will help to keep the mouth fresh and aid in keeping up the patient's morale. It should be taken in small quantities from a measured container. The nature of the fluids will vary, but fruit-juice, beef-tea, milk, soda-water and cups of tea are commonly used. It is said that glucose should not be added to drinks because if it is inhaled pulmonary œdema follows very readily. However, if the stomach is always emptied of fluid by passing a tube before giving an anæsthetic, even when glucose has not been used, the objection does not arise; glucose is valuable in preventing ketosis in labour. Whenever a patient has been in labour 24 hours without much progress, the whole situation is carefully reviewed, including the patient's general condition and state of hydration. If it is satisfactory no additional measures may be necessary; but if, as so often happens in disorderly uterine action, ileus is beginning with gastro-intestinal distension and vomiting, her fluid, food and electrolyte requirements are better given intravenously and a Ryle's tube retained in the stomach for repeated gastric aspiration. The intravenous route may also be used for giving antibiotics and in carefully selected cases, oxytocin and pethidine.

Fluid and Electrolyte Requirements.—The average adult needs 2 litres of water and 5 gm. of sodium chloride every 24 hours for basic requirements, but in hot weather and with a restless patient another $\frac{1}{2}$ litre is needed making a total of $2\frac{1}{2}$ litres. The amount of fluid lost through vomiting or gastric aspiration would need to be added. Basic needs are met in an otherwise uncomplicated case by giving 4 per cent. glucose in $1/5$ normal strength saline. In pre-eclamptic toxæmia 5 per cent. glucose would be used unless vomiting and the disappearance of chlorides from the urine made some additional saline temporarily necessary. The state of the urine indicates the type of fluid needed. In cases of acetonuria 5 per cent. glucose would be substituted for the standard

fluid and if the urinary chlorides are low normal saline. Serious electrolytic disturbance could be checked biochemically, but labour should never be allowed to continue long enough for this to happen.

Hypokalemia may well appear when disorderly uterine action has been present for 36 to 48 hours; the symptoms being sleepiness, weak pulse and weakness of muscle power, causing gastro-intestinal dilatation, retention of urine and perpetuation of ineffective uterine action. The reserves of potassium in the body, however, are very great and there needs to be emphatic blood-chemistry evidence of depletion before intravenous replacement is made and then only with the greatest caution.

Sedative Drugs.—Too much stress cannot be given to the need for the administration of adequate quantities of sedative drugs in prolonged labour, especially in that due to disorderly action. Usually far too small amounts are prescribed in the mistaken belief that they will make the ineffective action even less effective; in fact the reverse is more commonly the case. Further, the need in weak hypotonic inertia is usually only for a good hypnotic at night, usually a barbiturate; in painful disorderly action one of the pain relieving analgesics is the crying need. Morphia gr. $\frac{1}{4}$ and hyoscine gr. 1/150, or pethidine 100 mg. and hyoscine gr. 1/150, are usually very effective in giving suitable rest; it is important for the analgesics to be given at night, unless delivery is imminent. If there is doubt about the speed of progress it would be safer to give morphia and pethidine, for then the inhibitory effect of both can be counteracted either by giving the mother 10 mg. of nalorphine intravenously 10 to 15 minutes before delivery, or by injecting 0.25 mg. into the umbilical vein at delivery if the baby is slow to breathe. Nalorphine given in greater dosage or when not used to counteract morphia, its derivatives or pethidine and allied drugs, depresses respiration. Pethilofan which contains both pethidine and nalorphine, can be used instead.

When less powerful analgesic action is needed a combination such as pethidine and methylpentynol, oblvion, repeated four to six hourly, not uncommonly has an accelerating effect on the labour by reducing spasm and relieving pain. Continuous intravenous pethidine (300 mg. in 1 litre of 5 per cent. glucose saline) can be used very effectively in hypertonic states to control pain and at the same time to adjust fluid and electrolyte levels.

Continuous caudal analgesia has been used with a good deal of success in disorderly uterine action. As would be expected pain is completely relieved; in a high percentage of cases the tension and spasm in and around the lower segment and cervix are reduced to such an extent that the second stage of labour is often reached within 4 to 6

hours after the injection. The method is to inject 40 ml. of metycaine up the caudal canal with well defined precautions using an indwelling malleable needle. Further injections of 15 ml. are given at $\frac{1}{2}$ -hourly intervals. The chief disadvantage of the method is occasional difficulty in inserting the needle. It is only suitable for institutional midwifery.

The analgesics mentioned so far, with the exception of caudal analgesia, only apply to the first stage of labour. Control of pain in the second stage following a prolonged first stage follows the usual indications and is met by giving the usual inhalation anaesthetics.

Antibiotics.—In prolonged labour if there is evidence either from the temperature chart, or from the character of the escaping liquor, or from an unexpected and sustained rise in the foetal heart-rate that genital infection has taken place, antibiotic therapy and chemotherapy should be begun immediately. A high vaginal swab for organisms and sensitivity is taken and, whilst awaiting the report, penicillin and triple sulphonamide therapy is begun. Even without frank evidence of infection it is now standard practice to start antibacterial therapy after any labour has lasted 48 hours and it is especially important if the membranes have ruptured. It is done not only for the sake of the patient, but also to prevent infection of the foetus *in utero*. When there are signs that intra-uterine infection has taken place, no time should be lost in delivering the patient; by Cæsarean section under full antibiotic cover if vaginal delivery is considered unsafe.

Preparation for Anaesthesia.—It is of great importance to pass a tube and aspirate the stomach before an anaesthetic is given, because of the association of ileus with prolonged labour.

If only fluids have been given by mouth a narrow bore Ryle's tube passed *via* the nose will suffice and will not be too upsetting. If solids have been given within the preceding 8 hours a wide-bore tube must be used or apomorphine given to promote vomiting because the stomach empties slowly in labour. It is preferable to correct fluid and electrolyte balance before giving an anaesthetic.

SPECIAL MANAGEMENT

Primary Uterine Inertia.—This diagnosis calls for a most careful examination of the patient to make sure that there is no question of unsuspected disproportion. The baby is not uncommonly very large which may prove to be an indication for interference later on if good progress is not made.

When there is no doubt that slow labour is due to hypotonic uterine action it is worth considering the use of continuous intravenous oxytocin.

Intravenous Oxytocin. The conditions governing its use are the absence of disproportion, the observation of labour for at least 24 hours, hypotonic uterine action and the membranes ruptured either spontaneously or artificially. The method is suitable only for institutional midwifery and would only be used under the guidance of someone of experience.

Two and a half units of oxytocin (pitocin or syntocin) are thoroughly mixed in a bottle (540 ml.) of 5 per cent. glucose, glucose saline or normal saline. The needle is inserted into the radial vein just above the wrist; the tube leading to the needle is looped round the thumb and strapped in order that the patient can move her arm quite freely and comfortably. The drip is begun with 40 and 80 drops a minute and the response observed over the next 30 minutes. If the case has been satisfactorily chosen no untoward effects are found either as regards the foetal heart-rate or the uterine contractions. In the large majority of cases the quality of action improves greatly and satisfactory progress is now made. The drip is kept running between the wide limits of 40 to 80 a minute because it is impossible to maintain a continuous drip at a constant rate, but it is better to aim at the lower level. It is usual to keep the drip running until the third stage is over, although the rate can be reduced if necessary.

Once the full effect of the intravenous oxytocin has been observed over the first half hour, the patient is treated as if she were undergoing a trial labour.

Forceps Delivery. -When a patient reaches the second stage after a tediously long first stage, she is often too tired to push: it is then fully justifiable to aid delivery with forceps without further delay as long as the usual conditions are fulfilled. If foetal distress arises when the cervix is not quite fully dilated, dilatation can be completed by pushing the cervix up with the hand and delivering the child with the forceps.

Secondary Uterine Inertia (Uterine Exhaustion). -Uterine activity having ceased in the second stage through muscle fatigue the management will depend on the condition of patient and foetus. If the foetal heart-sounds are satisfactory the patient will often benefit from being given a sedative to produce sleep. When she awakes pains are likely to return and she can be delivered safely with forceps. On the other hand if urgent delivery in the absence of uterine contractions is necessary an oxytocin drip should be set up, the patient anaesthetized and the child delivered with the forceps. Because in this case two predisposing factors to post-partum hæmorrhage are present, anaesthesia and uterine fatigue, it is advisable to have blood ready for

transfusion and to give 0·25 mg. ergometrine intravenously and 0·25 mg. intra-muscularly when the anterior shoulder has been delivered.

In the third stage owing to secondary uterine inertia the uterus is relaxed which results in a delayed third stage without bleeding if the placenta has not begun to separate or with bleeding if it has. In the absence of bleeding nothing need be done for an hour, in the hope that returning tone will effect separation and expulsion of the placenta. If after an hour separation has not taken place, it is advisable manually to remove the placenta under anæsthesia.

Should bleeding begin at any time during the waiting period, immediate manual removal is indicated. Ergometrine is given in the manner already described.

Precipitate Labour.—If the labour is really precipitate there is no treatment as it occurs in the absence of a doctor or midwife; all that can be done is to keep the patient lying down. The lower genital tract should be carefully examined for injuries at a suitable opportunity. When medical aid is available an anæsthetic, such as ether or chloroform, should be given to diminish the intensity and frequency of the contractions, and an episiotomy may be needed to avoid a third degree perineal tear.

Obstructed Labour.—This condition should never be allowed to develop for it represents negligent or unskilled management. The predisposing causes of obstructed labour should be obvious early in labour with careful supervision. When it develops during labour, *e.g.* when a deflexed head becomes converted to a brow presentation, the fact that the presenting part has become arrested in spite of strong contractions should be obvious long before the late signs of obstructed labour develop.

Once it has appeared urgent help is needed because at any moment the uterus may rupture. Two things have to be done quickly. The first is to anæsthetize the patient quickly to inhibit the powerfully retracting upper segment. Chloroform is the best anæsthetic, but care and skill are needed as it carries its own dangers. The second is to deliver the child as quickly, though as carefully, as possible. The foetus is usually dead, but this does not mean that embryotomy is the safest method of treatment. Whilst decapitation can often be done safely in a shoulder presentation, it is far too late and too dangerous to consider internal version. Cæsarean section today with effective antibiotic cover is usually the safest means of delivery in advanced obstructed labour, even when the foetus is dead. If the foetus still lives, it is always indicated.

Inco-ordinate Uterine Action can only be treated symptomatically until methods of diagnosis become more precise, and even then only when effective drugs to act selectively on the lower uterine segment and reduce its tone have been discovered. What has been said about the general management of prolonged labour applies particularly to disorderly uterine action. The emphasis is on the relief of pain and

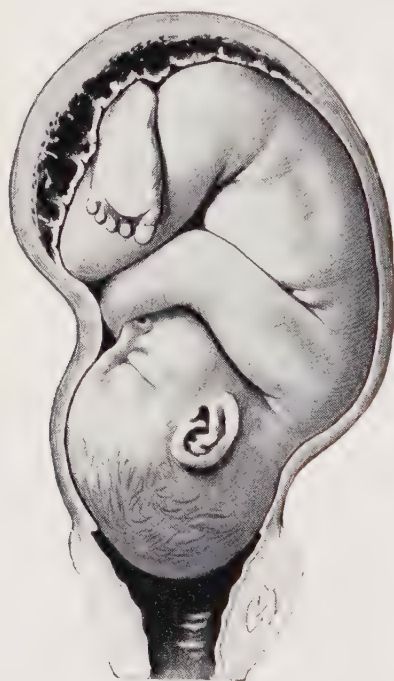


FIG. 92.—THE IRRITATED OR GENERALLY CONTRACTED UTERUS.

The uterus as a whole closely embraces the foetus, but the lower uterine segment does not show thinning.



FIG. 93.—THE CONTRACTION RING.

The foetus is closely embraced by the uterus round the neck, where it is gripped by a constricting band. There is not any thinning of the lower uterine segment.

lowering of hypertonus; to this end full consideration should be given to continuous intravenous pethidine and to continuous caudal analgesia.

Unfortunately, Cæsarean section still plays a big part in the treatment, it should be resorted to as soon as conservative measures have failed. It is at present the only answer when progress has ceased in the first stage and the cervix is not sufficiently dilated for manual dilatation and forceps delivery.

Vaginal Procedures.—If labour reaches the second stage the child should be delivered with the forceps without delay to save further

stress to an already tired patient and anoxic foetus. But progress may cease before full dilatation is quite reached. The cervix can be manually dilated if conditions permit. For it to be safe the head must be well down in the pelvis and in an anterior position, the cervix thin and at least three parts dilated ; the operation must be carried out in hospital. One of the chief dangers is laceration of the cervix ; the tear may extend upwards and involve a large vessel with consequent hæmorrhage.

Cervical incision is occasionally indicated in similar circumstances, the cuts being made bilaterally. The same skill, judgment and risks as with manual dilatation again operate. Both procedures must be followed by forceps delivery and the cervix immediately inspected and repaired.

Contraction Ring Dystocia.—A contraction ring in the first stage is managed like any other form of disorderly action. Rarely it forms below the head when it may be possible to feel it through the cervix. Cæsarean section is indicated. A contraction ring in the second stage of labour is most commonly found unexpectedly, usually after forceps have been applied and traction has unaccountably failed. By palpating above the head in the region of the neck the contraction will be felt. Success often follows the administration of amyl nitrite by inhalation under an anæsthetic mask ; because the action is only short-lived, the forceps should already be in position and the operator ready to apply traction when the drug is given.

Deep anæsthesia is usually sufficient to allow the hand to pass through a contraction ring in the third stage of labour, although amyl nitrite may be used in addition.

Cervical Dystocia.—In the primary forms this condition is treated like any other form of disorderly uterine action. Cæsarean section is commonly needed but if the cervix is nearly fully dilated then manual dilatation, or incision, might be considered under the same conditions as those already mentioned.

Secondary cervical dystocia is found more commonly in multiparæ and so the contractions are often of normal strength and character. If dilatation is not progressing steadily under these conditions Cæsarean section should be decided on quickly before the scarred cervix has a chance of splitting, possibly into the lower segment.

CHAPTER XXVIII

OBSTRUCTED LABOUR

THE term "obstructed labour" has largely been displaced by the word *dystocia* which means difficult labour. This condition is best considered under three headings :

1. Dystocia due to abnormalities of the expulsive forces.
2. Dystocia due to maternal conditions.
3. Dystocia due to foetal conditions.

The first has already been discussed in the preceding chapter XXVII. The reader can best appreciate the variety and number of conditions which can produce obstructed labour from the following table, but it is most important to note and to understand at this stage the fact that obstructed labour is not inevitable in the case of any that are listed.

1. *Maternal Conditions which may lead to dystocia.*

- (a) Contraction or deformity of the bony pelvis.
- (b) Uterine or ovarian tumours.
- (c) Bony tumours of the pelvis.
- (d) Stenosis of the cervix or vagina.
- (e) A contraction ring in the uterus.

2. *Foetal Conditions which may cause dystocia.*

- (a) Malposition of the foetus.
 - (i) Persistent posterior position of the occiput.
 - (ii) Deep transverse arrest of the foetal head.
- (b) Malrepresentation of the foetus.
 - (i) Breech presentation.
 - (ii) Face presentation.
 - (iii) Brow presentation.
 - (iv) Shoulder presentation.
 - (v) Locked twins.
- (c) Congenital abnormalities of the foetus.
 - (i) Gigantism.
 - (ii) Hydrocephalus.
 - (iii) Hydrops foetalis.
 - (iv) Foetal abdominal tumours or ascites.
 - (v) Double monsters.

Labour is said to be obstructed when there is absence of progress in the presence of strong uterine contractions. Such absence of progress may be shown in failure of the cervix to dilate or failure of the presenting part to advance in its descent. Antenatal care and observation have done much to lessen the incidence of obstructed labour in the detection during pregnancy of some of the causes which have been mentioned above. Thus it may be possible to lessen the likelihood of obstruction by the detection and correction in pregnancy of foetal malpresentations. Alternatively the diagnosis of pelvic contraction, or the diagnosis of disproportion from any cause, or the discovery of a pelvic tumour during pregnancy, is likely to lead to consideration of a definite plan of action in the conduct of the subsequent delivery of the baby. Antenatal care, however, has not as yet succeeded in abolishing all causes of obstructed labour. For instance little, or nothing, can be done to foresee or lessen the incidence of failure of the cervix to dilate. However, there is a general appreciation of the dangers of delay in labour and of the necessity for its early detection as it is one of the first signs of a possible, and perhaps unsuspected, cause of obstruction.

All the maternal conditions are described fully in their appropriate chapters and there follows only a brief review in which an attempt is made to help the reader view this important condition in its correct perspective.

Obstruction in labour is always relative. Thus in the presence of poor contractions of the uterus, or, in the second stage of labour, of poor expulsive efforts, a minor abnormality may produce serious obstruction. In contrast, if the uterine contractions are strong and are efficient in their action they may overcome, often with remarkable ease, what would appear to have been an almost inevitable cause of obstruction. Dystocia may have been present in a first labour, and may be observed not to exist in the second or subsequent confinement even when the cause is known to be a minor degree of contraction of the pelvis. Certain causes of obstruction present problems of extreme or even insoluble difficulty. Thus it is often not possible in many cases of contracted pelvis accurately to forecast how labour will progress; or uterine, and even ovarian tumours lying in the pelvic cavity below the presenting part of the foetus may be drawn upwards during labour; or lastly, in the case of some of the malpresentations of the foetus the labour proceeds normally and the delivery of the baby is easy and spontaneous. It is less difficult to diagnose a cause of obstructed labour when the pelvic contraction is present at the pelvic brim because this will produce non-engagement of the foetal head during the last weeks of pregnancy and in labour. Deformity or contraction when it affects the cavity or outlet of the pelvis is altogether a different problem and every means

possible has to be used in an attempt accurately to assess the capacity of the bony pelvis at these levels.

What may be termed overgrowth of the fœtus is found to occur in many cases of maternal diabetes and more rarely in women whose pregnancy has continued long past the calculated expected date of delivery. The latter is probably very rare, but in both conditions the onset and development of the abnormality is not difficult to detect or to assess provided that the patient is examined at each antenatal visit by the same practitioner. In both cases not only may the large and perhaps well ossified foetal head provide the cause for dystocia, but especial difficulty is likely to occur in the delivery of the rigid shoulder girdle.

Moderate degrees of hydrocephalus, meningocele and encephalocele may not cause obstruction ; when these abnormalities are pronounced obstruction may result.

Organic constriction of the cervix or vagina may be congenital, or may be due to fibrosis following trauma and infection. Scarring of the cervix from previous laceration, or after amputation of the cervix, occasionally offers great resistance to dilatation. Atresia of the vagina, sufficient to delay or prevent the birth of the child, may be congenital, or may result from vaginitis, or from plastic operations for prolapse. Delivery *per vaginam* is fraught with the danger of severe laceration and the possible production of a vesico-vaginal or recto-vaginal fistula. The treatment is Cæsarean section.

Contraction ring of the uterine muscle has been described in the preceding chapter. It may not only occur in cases of undiagnosed, and therefore neglected, cases of obstructed labour, but may result from unskilled and ineffective efforts to assist delivery. It provides an insuperable obstacle to delivery.

Occasionally in multiparous women the abdominal walls are so lax as not to form any support to the enlarging uterus during the last few weeks of pregnancy. The laxity may be so pronounced and the devarication of the muscles so marked that the unsupported uterus falls forwards with its axis pointing backwards. This, together with non-engagement of the foetal head may provide a cause for dystocia. The provision of an efficient binder to support the uterus may help these women.

Emphasis has already been given to the importance, especially in what may be termed minor causes of dystocia of obstructed labour, of the strength and efficiency of the uterine contractions. Mention was then made of the fact that dystocia in a first labour may not be followed by dystocia in a second or subsequent confinement owing to a greater degree of efficiency in the process of labour. However, if the woman has borne many children dystocia may, and probably will,

reappear for two reasons. Her uterine musculature seems gradually to become enfeebled with repeated childbearing and there is a tendency for a progressive increase in the size of succeeding babies.

The symptoms and signs of obstructed labour are best considered as follows :—

1. Signs of impending obstruction.
2. Signs of established obstruction.

Let it be said at once that the second group should rarely, or perhaps never, occur in any properly run obstetric practice or department.

1. Impending Obstruction

The importance of the early detection of possible obstruction in labour is obvious, for if labour is allowed to progress to the point of absolute obstruction the death of the foetus is almost certain and the life of the mother is endangered. A careful watch is always kept on the general condition of every woman during labour and probably the earliest sign of impending obstruction is a deterioration in the woman's general condition. The patient looks tired and for the first time behaves as though she is beginning to lose her ability and will to co-operate. A competent nurse will always detect these changes and may report that the frequency and strength of the contractions are diminishing. If neglected this patient will enter a stage of exhaustion both in herself and in her uterus, but given rest the relief is only temporary, for obstruction will not be overcome in the interval. Between the pains the woman seems unable to relax and her anxiety increases. Whenever there is non-engagement of the presenting part early rupture of the membranes is likely to occur. This may be taken as a possible sign of pelvic bony deformity or contraction, or of poor flexion of the foetal head in the case of a cephalic presentation. Vaginal examination may show that the cervix is no longer applied to the foetal skull and this finding has been described accurately in the words "the cervix hangs like a curtain". A large caput succedaneum soon develops and gross over-riding of the cranial bones may be noticed. While this is taking place the patient's tiredness or exhaustion becomes more and more pronounced. Gradually the state of impending obstruction merges to that in which all progress is arrested and the obstruction is established.

2. Established Obstruction

When this occurs a rise occurs in the patient's temperature and a steady and decided rise in her pulse and respiration-rates. The blood-pressure readings also increase. Partly through her inability to take,

or to absorb food, her general state becomes further impaired by the onset of ketosis. The quantity of urine secreted diminishes greatly and it is concentrated and deeply coloured. Ketones are present in large amounts and these substances can be smelt in the patient's breath. Œdema is likely to develop and the cessation of secretions is shown in the dry furred tongue and the absence of mucous secretion from the cervix and of the vaginal transudate. The last signs that have been described must be regarded as terminal. As has been stated, early diagnosis and the taking of appropriate steps toward their prevention is usual in every well run obstetric practice or department. The likelihood of obstructed labour should be suspected if at any time the labour fails to progress. Thus in the first stage dilatation of the cervix should be continuous, albeit sometimes it is not rapid. Descent of the presenting part also should be continuous throughout labour and especially so in the second stage. Any failure in the progress of labour demands the most thorough and searching examination and investigation in order to discover a possible cause, or at least to confirm the absence, of a serious complication. If ordinary clinical examinations do not result in definite findings they should be repeated when the patient has been anæsthetized. In cases of suspected disproportion due either to pelvic contraction at any level or to the presence of an abnormally large foetus, X-ray examination can be most helpful and, if the confinement is being conducted in a hospital, can be made during the labour.

If for some reason the diagnosis of established obstruction has been missed, and this unfortunately may happen even to-day, a rapid deterioration in the woman's general state occurs. Certain changes in the uterus must be described which, apart from their important influence on the correct management of the condition, inevitably cause the death of the foetus and endanger the life of the mother.

The Uterus in Obstructed Labour

This condition was known as tonic contraction of the uterus, but it is essentially one of over-retraction, and is more correctly called *tonic retraction of the uterus*. It is often slow and insidious in its onset, taking several hours to develop. The first stage of labour may progress normally.

In the course of normal labour some retraction persists after each contraction, the upper segment becomes slightly thicker and shorter as the foetus descends, but the lower segment is not unduly stretched (Fig. 94). If the foetus is unable to descend, the total length of the uterus must remain constant. In obstructed labour therefore, pro-

gressive retraction causes greater thickening of the upper segment, with consequent over-stretching and thinning of the lower segment. This is pathological retraction and its occurrence sooner or later must be regarded as inevitable in a case of obstructed labour (Fig. 95). The line of junction of the upper and lower segments is known as the



FIG. 94.—DIAGRAMMATIC REPRESENTATION OF NORMAL LABOUR, SHOWING THE SYMMETRICAL SHAPE OF THE UTERUS.

The child is nowhere closely embraced by the uterus and there is room for liquor amnii.



FIG. 95.—TONIC RETRACTION OF THE UTERUS.

The upper segment of the uterus is thickened, the lower segment thinned. The uterus as a whole closely embraces the fœtus.

retraction ring of Bandl, which becomes more marked and moves slightly upwards as the condition progresses. Eventually, rupture of the uterus occurs at the junction of the upper and lower segments of the uterus. Death of the fœtus results from compression of the placental-site circulation.

Symptoms and Signs of Tonic Retraction

Labour may progress normally during the first stage, but when the progress of the fœtus becomes obstructed, the uterine contractions

usually increase in force and frequency and are often accompanied by strong bearing down efforts. After a time the mother becomes exhausted. She is usually restless and looks drawn and haggard. Pain is severe and continuous. Her tongue and lips become dry and discoloured, the pulse-rate is 140 or over, and the temperature may be raised to 100° F. or more.

On abdominal examination, the uterus is found to be moulded to the shape of the foetus, it is hard all the time, and does not relax, as it normally does, between contractions. The uterus is also very tender on palpation. A transverse ridge, the ring of Bandl, may be seen or felt at the junction of the upper and lower segments. Foetal parts cannot be clearly felt, and the foetal heart is not heard because tonic retraction inevitably causes foetal death. The presenting part is fixed at the level of the obstruction. The obstruction nearly always occurs in the cavity or at the outlet of the pelvis: it is very rare nowadays for serious obstruction at the pelvic brim not to have been detected during the last weeks of pregnancy.

On vaginal examination, the vagina and vulva are oedematous, and the birth-canal is hot and dry. The oedematous cervix may be felt below the presenting part. If the head is presenting, there will be a large caput succedaneum and marked moulding of the cranial bones. In the course of time and in a grossly neglected case the presenting part cannot descend. Owing to the repeated retraction of the uterine muscle it becomes tightly fixed. Even under anæsthesia it cannot be pushed upwards without great danger of uterine rupture indicating that impaction has occurred. If the shoulder is presenting, it is impacted and oedematous, the arm may be prolapsed and the hand projecting from the vagina.

DIFFERENTIAL DIAGNOSIS

Concealed accidental hæmorrhage may bear a superficial resemblance to tonic retraction if the patient is first seen in a condition of shock. The mistake, however, should never be made. In the former condition the patient has never been in labour, whereas in the latter labour has been established for many hours. In concealed accidental hæmorrhage the uterus is hard and tender, foetal parts cannot be felt and the foetal heart is not heard; on vaginal examination there are no signs of impaction, and no cause of obstruction is found. Tonic retraction must not be mistaken for uterine inertia or uterine irritability, in which the uterus does relax, and the presenting part is not impacted.

TREATMENT

1. Prevention of Tonic Retraction.—Tonic retraction should never be allowed to develop, because the cause of the obstruction should have been discovered during pregnancy or early in labour, and appropriate treatment adopted.

2. Treatment of Tonic Retraction.—When tonic retraction has developed, the aim of treatment is to deliver the patient as safely and as quickly as possible. In every case tonic retraction causes the death of the foetus. Intra-uterine manipulations are very liable to cause rupture of the thinned lower uterine segment, and are therefore contra-indicated. Version is particularly dangerous, and attempts at forceps delivery will fail. The foetus is certainly dead and delivery will be effected only after some destructive operation, or by Cæsarean section. Both are hazardous procedures. It is probable that Cæsarean section is the safer method. The improved technique of the lower segment operation, the use of sulpha drugs and antibiotics, modern methods of anæsthesia and blood-transfusion have all helped to lessen the dangers of this operation. Destructive procedures are usually lengthy, difficult and dangerous.

The patient should be removed to hospital; a delay of an hour is unlikely to cause rupture of the uterus, if the patient is fully under morphia. Tonic retraction must always be regarded as a grave emergency.

If craniotomy is decided upon, full surgical anæsthesia should be induced and maintained until delivery, which should be completed as quickly as may be compatible with the safety of the mother. In cases of disproportion the head must be perforated, and delivery effected with the craniotomy forceps. With an impacted shoulder presentation, decapitation is necessary, and with foetal abnormalities some form of embryotomy will be required. With extreme degrees of pelvic contraction or with large pelvic tumours when delivery *per vaginam* is impossible even after craniotomy, Cæsarean section is the only possible method of treatment. It is attended by considerable risk if the patient has been long in labour, and particularly if attempts at delivery *per vaginam* have already been made. The operative details of craniotomy are described on p. 554 (Chap. XL).

CHAPTER XXIX

VERTEX, FACE AND BROW PRESENTATIONS

OCCIPITO-POSTERIOR POSITIONS OF THE VERTEX

THE mechanism of labour in the third and fourth positions of the vertex has already been referred to in Chapter XIII. In most cases in which the occiput lies posteriorly labour progresses normally. This is likely to occur in the first place because the foetal head is sufficiently flexed and, secondly, because the dimensions and shape of the bony pelvis are normal and adequate in the majority of women. With good flexion of the head the occiput, being the first part of the skull to meet the pelvic floor, usually undergoes a long rotation forward through three-eighths of a circle and is thus directed to the open space beneath the pubic arch. In about one-fifth of the cases of posterior position of the occiput this does not occur and the malposition remains uncorrected. A short rotation of one-eighth of a circle then takes place which results in the occiput being directed backwards to lie in the hollow of the sacrum. Formerly it was believed that this was nearly always due to the poor flexion of the foetal head which indeed is more likely to accompany the occipito-posterior position. As the result of poor flexion it is possible that the first part of the foetal head to reach the pelvic floor would be the sinciput, and this part of the foetal head would therefore rotate forward through one-eighth of a circle, the occiput perforce having to rotate a corresponding distance backwards. That poor flexion of the foetal head is not the only factor is now certain. The direction of any rotation of the foetal skull, and indeed the outcome of labour is known to be influenced by the shape of the bony pelvis especially in the dimensions of the cavity and outlet of the pelvis. In the android or anthropoid type of pelvis there is narrowing of the pelvic cavity from side to side and the size of the cavity tends to diminish in the lower straits. The angle of the pubic arch is likely to be acute and the ischial spines to project more into the birth canal. There tends therefore to be less room in the anterior part of the pelvis and the slight deformity of the pelvic shape appears to prevent a complete anterior rotation of the occiput, even in the presence of complete flexion of the foetal skull. It is possible therefore to find persistent posterior position of the occiput with complete flexion of the foetal head. That the shape of the pelvis is responsible for the persistent occipito-posterior is strongly suggested

by the repeated occurrence of this malposition in the subsequent labours of individual women.

Lastly it seems that the long rotation of the occiput forwards through three-eighths of a circle may be interrupted when the projection into the pelvic cavity of the spinous processes of the ischia is more pronounced than usual. Descent of the foetal head well into the cavity of the pelvis would not be prevented, but such undue prominence of the ischial spines could arrest the rotation of the foetal head so that it lies transversely, the occiput being to one side of the pelvis and the face to the other. In this position further descent is arrested. The problem is considered at greater length later in this chapter.

DIAGNOSIS

Diagnosis during pregnancy is of little consequence, except that occipito-posterior position must be recognized as a cause of deflexion and non-engagement of the head until labour commences. In labour the fact that flexion is incomplete may be suggested by early rupture of the membranes. It is also possible that the poorly flexed head is less effective in causing dilatation of the cervix, and it is quite frequently associated with uterine inertia and with painful spasmodic uterine contractions.

Abdominal Examination.—The diagnosis should be made without difficulty by abdominal examination in the interval between uterine contractions. Slight flattening of the abdomen may be observed, and the limbs, being in front, are easily felt. It may be difficult to define the back or to hear the foetal heart. This should be listened for well to the side of the abdomen, but it may sometimes be best heard near the mid-line. When the latter is the case it is probable that the heart sounds are heard through the chest wall and this may be taken as evidence of the lack of general flexion of the foetus. The head should descend normally through the pelvic brim as labour progresses, but descent may be slow owing to poor flexion. Failure of the foetal head to engage in the pelvic brim after the onset of labour should always be regarded as a sign of some possibly serious abnormality. When the foetus is in an occipito-posterior position failure of the head to engage may be due to poor flexion of the foetal head, but it may also be caused by contraction of the brim, as in an android type of pelvis.

Vaginal Examination.—Early in labour it may be difficult to reach the presenting part, and the bag of membranes may bulge in an elongated manner and rupture early. When the head has entered the pelvic cavity the most striking feature is the ease with which the

anterior fontanelle can be felt. This fontanelle is directed forwards and to the left in the R.O.P. (third vertex), forwards and to the right in the L.O.P. (fourth vertex). An attempt should be made to assess the degree of flexion of the head, as the well flexed head rotates more easily. Palpation of the posterior fontanelle indicates full flexion. If the anterior, or if anterior and posterior fontanelles, are felt the foetal head is poorly flexed.

Although the diagnosis should be made early in labour, it not infrequently happens that the position is unrecognized until there is delay in the second stage of labour. Diagnosis by vaginal examination may then be difficult owing to the formation of a caput succedaneum over the presenting part. The position of the fontanelles and sagittal suture is now of great importance. It may be found that the sagittal suture is lying transversely, the fontanelles being felt on either side; this is known as deep transverse arrest. Or it may be found that the sagittal suture is more or less antero-posterior, with the anterior fontanelle in front: this is known as a persistent occipito-posterior position.

When there is doubt as to the position of the occiput, an attempt should be made to feel an ear, the free border of which points to the occiput. This examination will have to be made under an anæsthetic, which is always necessary in order to discover the reason for delay in the second stage in labour.

The Course of Labour in Occipito-Posterior Positions

This malposition may cause difficulty in labour. The presentation is that of the vertex and during the last weeks of pregnancy all may seem to be well because the foetal head has been found to be engaged in the pelvic brim. The first sign of trouble, therefore, will not appear until labour has been in progress for many hours, or even until the second stage of labour has been reached. In other cases in which the malposition has been diagnosed, and even in which the non-engagement of the foetal head has been consistently noted, the subsequent labour may be entirely normal in that the first stage is not prolonged, and the birth of the baby occipito-anterior is unassisted.

Again, especially in multiparous women, but quite frequently in the birth of a first baby, labour progresses entirely satisfactorily and, often to the surprise of the practitioner or midwife, the baby is born without any difficulty, directly occipito-posterior in position, or as it is termed face to pubes.

Yet another difficulty is provided in that whereas diagnosis of the malposition in pregnancy presents no difficulty, nothing can be done

at that time towards its correction. While there is thus no absolute need to suggest that arrangements be made for the confinement to take place in hospital, in this particular malposition it is particularly true that the course of labour is unpredictable and serious delay or even obstruction may occur. Frequently an experienced midwife will accurately suspect, from her observations early in the first stage, the probability of delay in labour, and therefore the need for subsequent assistance. She may note that the uterine contractions, while painful, are poor in quality or colicky in nature, and may refer to them as "posterior-position pains". It is possible that the poor flexion of the foetal head fails to provide that reflex stimulation of the lower segment which is thought to be produced by the more pointed vertex in the case of full flexion.

A long first stage of labour in itself is likely to be followed by a long second stage for the woman is tired and the uterine muscle may be incapable of further strong contractions. Failure of progress in the second stage of labour demands a thorough examination to determine the exact cause of the delay. Assistance can be given to hasten the delivery of the foetus only after such an examination has been made.

Whether an occipito-posterior position was known to exist at the onset of labour or not, or whether the occiput is thought to have rotated completely or partly forward, or to have remained posterior in position, does not matter. Such delay demands the most careful examination to determine the cause, and in view of the necessity for subsequent assistance the examination is better made after the patient has been anæsthetized. Lastly, repetition is made, and with emphasis, of the statement that it is never possible to forecast in the case of this malposition what will happen in labour and that the baby may be born, as has been stated already, without difficulty face to pubes.

Moulding of the Head in Occipito-Posterior Positions

A knowledge of the moulding of the foetal skull is of practical importance as it affects the making of the diagnosis, and influences the nature of assistance when this is necessary.

When the foetal head descends into and down the birth canal and flexion of the head is poor the skull will be compressed in the occipito-frontal diameter. This change in the shape of the foetal head is shown in Fig. 97. Often, for instance if the foetus is of normal size or not unduly small, or alternatively if the mother's pelvis is not large or even slightly contracted, the moulding will be most pronounced. If the change in shape is brought about fairly rapidly as the result of strong and frequent contractions of the uterus, the structures in the skull are

unlikely to be able to adapt themselves to the relatively sudden change in shape. Great compression along the occipito-frontal diameter usually causes a tear or rupture in the posterior vertical part of the

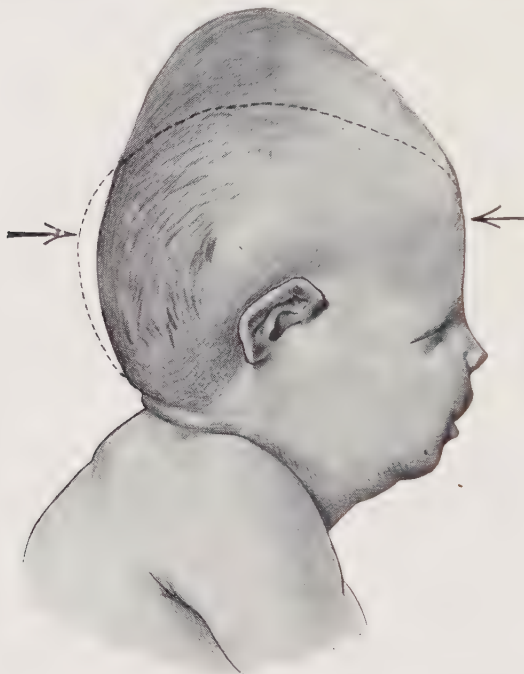


FIG. 96 — MOULDING OF THE HEAD IN PERSISTENT OCCIPITO-POSTERIOR POSITIONS.

The dotted outline shows the shape of the head before moulding. The occipito-frontal diameter has been compressed, with the result that the head has been lengthened in a vertical direction.

falx cerebri and foetal death results from intracranial hæmorrhage. Slow moulding may allow the falx and the tentorium cerebelli to adapt themselves to the altered shape of the skull by stretching.

Management of Labour

A persistent posterior position of the occiput does not always cause obstruction. Many large babies, especially in parous women, are delivered face to pubes without any difficulty. Nevertheless owing to the increased incidence of deficient flexion of the foetal skull in occipito-posterior position and also to the fact that this malposition may be associated with certain forms of pelvic contraction and deformity, particularly the android and anthropoid pelves, there is definitely a

greater incidence of obstructed labour compared with the occipito-anterior positions.

The First Stage of Labour. The first stage of labour is managed exactly as described in Chapter XIII. Nothing can be done to correct the malposition, or to influence the direction or amount of internal rotation of the head. The patient may walk about between the contractions if she is not tired; she is given small and frequent meals; retention of urine is not allowed to occur and, perhaps most important of all, when she is tired effective steps are taken to ensure rest and temporary relief from pain. The routine observations include an assessment of her general condition, the frequency, strength and duration of the contractions, and regular note of her temperature, pulse-rate and blood-pressure. The quantity of urine secreted is measured and the urine examined for the presence of abnormal constituents, especially ketone bodies. As and when it is thought to be necessary vaginal or rectal examinations are made to estimate the progress of labour by observing the rate of dilatation of the cervix and of descent of the head. If the anterior fontanelle presents the head is poorly flexed. The finding of a large caput succedaneum or of marked overlap of the bones of the foetal skull is most important and should be regarded as signs of probable and impending obstructed labour. As long as labour progresses, even though the progress be slow, and as long as the condition of the mother or of the foetus gives no cause for anxiety there is no indication for any interference.

The Second Stage of Labour.—When from the change in the character and strength of the contractions there is reason to believe that the patient has entered the second stage of labour it is advisable to make a vaginal examination. This is done in order to confirm the full dilatation of the cervix and to note the level to which the foetal head has descended into the pelvic cavity. Observations should also be made as to the presence and size of a caput succedaneum, the presence of any overlap of the cranial bones indicative of moulding of the foetal skull and lastly by feeling one or both fontanelles to determine the degree of flexion of the head and its position in the pelvis. If there are no signs of maternal or foetal distress there is no indication for interference at this moment. With the aid of strong uterine contractions helped by effective expulsive efforts of a co-operative patient who is not tired out, an unassisted delivery, the occiput having rotated to the front, can be expected in the majority of cases. The birth of the baby may even take place in the face to pubes position without any serious difficulty being experienced.

The indications for interference in the management of this malposition of the foetus are :

1. Failure of the presenting part to progress in spite of strong uterine contractions.
2. Maternal distress.
3. Foetal distress.

(The two latter conditions are discussed fully on pp. 514 to 517.)

A thorough and careful examination must be made in order accurately to determine the cause of the delay. In addition it is necessary to ascertain the exact position of the foetal head in the pelvic cavity and to note to what level it has descended. Not before all these points have been satisfactorily determined is it permissible, or even possible, to consider by what means assistance can be rendered. No condemnation can be strong enough for the haphazard application of the obstetric forceps in these cases, made in the desperate hope that strong traction will overcome most difficulties.

The very nature of the three indications mentioned makes the necessity for immediate interference almost certain. Therefore, the preliminary examination should be made after the patient has been anæsthetized. This saves the patient the discomfort of a somewhat difficult examination, and, more important, allows this examination to be more easily and more thoroughly performed. Arrest of the foetal head may occur,

1. Above the brim of the pelvis.
2. In the cavity of the pelvis.
3. At the outlet of the pelvis.

1. *Persistent occipito-posterior position — Arrest at the brim of the pelvis*

Arrest at this level is very rarely seen as non-engagement of the foetal head in the last weeks of pregnancy always demands a thorough investigation at that time. If, however, it were found in a patient who was in the second stage of labour delivery by Cæsarean section would be indicated.

2. *Persistent occipito-posterior position — Arrest in the cavity of the pelvis*

It is at this level that arrest usually occurs and it has already been explained that this may be due either to the malposition of the foetal skull, or to some deformity or contraction of the pelvic cavity or bony outlet. The former results in the presentation of an unfavourable diameter, the occipito-frontal, for passage down the birth canal. Examination should, therefore, determine the level of arrest, the exact position of the foetal head, and should decide that the pelvic cavity is not so contracted as to preclude delivery. Should gross pelvic con-

traction be discovered at this late hour, delivery by Cæsarean section is advised, especially if the foetus is alive. However, it is very seldom that such is the case and delivery by the vaginal route is usual and successful. With the knowledge that the occipito-anterior position of the foetal head presents a smaller and therefore more favourable diameter to pass through the birth canal, the first step to be taken to assist delivery is *rotation of the foetal head*. Rotation can be performed.

(a) Manually.

(b) With Kjelland's forceps.

The latter procedure is now frequently adopted but only by those who have been instructed in, and are familiar with, the use of the instrument.

(a) *Manual rotation*.—After episiotomy the hand is passed slowly into the vagina. The head is slightly displaced upwards and firmly grasped by the fingers and thumb. Rotation is accomplished by turning the head in the appropriate direction. Thus if the position of the foetus is R.O.P. the head is turned so that the occiput travels round the wall of the pelvis on the right side until the occiput is directly anterior. The opposite direction is chosen if the foetal position is L.O.P. In performing internal rotation certain points should be observed. It is a good plan to place one finger on a definite landmark of the foetal skull, *e.g.* an ear, so that the exact position of the head is always known and, secondly, it is important that the shoulder girdle be rotated at the same time as the foetal head. If this is not done the head will tend to leave the final correct occipito-anterior position after its rotation, and to slip back into an oblique or even into the transverse diameter of the pelvis. Rotation of the shoulder girdle is achieved usually by pressure on the shoulder with the outside hand through the abdominal wall.

Upward displacement of the foetal head has obvious disadvantages. Poor flexion may be made worse and the subsequent application of the obstetric forceps much more difficult. In order to avoid upward displacement an attempt should be made to procure the correct internal rotation of the foetal head by pressure on the vertex in the correct direction with the tips of the fingers. In experienced and skilled hands this manœuvre is often successful. After rotation to the occipito-anterior position has been successfully completed, the obstetric forceps should be applied in the usual manner as described on p. 526 and delivery of the baby completed with the aid of this instrument. If after their application the handles of the instrument do not lock, or if satisfactory descent is not immediately apparent on moderate traction, the instrument must be removed and a careful examination must be repeated. It is quite possible that in the interval between the completion of the

internal rotation and the application of the forceps the foetal head may have rotated back to its former occipito-anterior position. The forceps, therefore, will have been applied obliquely to the foetal head. Prolonged and forcible efforts to deliver the head in this malposition are likely to result in disaster. The instrument is not designed to grip the foetal head in any position other than the direct occipito-anterior position.



FIG. 97.—MANUAL ROTATION OF THE FÆTUS IN OCCIPITO-POSTERIOR POSITION.

The right hand passes between the pelvic wall and the foetal head and is about to rotate the head. The left hand placed on the abdomen will assist this rotation by pressure on the left shoulder.

Applied to the foetal head in any other position traction may cause the instrument to slip off. If this happens severe lacerations will be produced to the vascular vaginal walls and underlying tissues. Great force is likely to be necessary to procure descent, because unless directly occipito-anterior, additional moulding must occur in larger diameters of the skull. Force therefore is likely to cause intracranial injury and death from intracranial hæmorrhage. Lastly it is probable that no procedure is more likely to produce a contraction ring in the uterus than the use of repeated, forcible, unskilled and unsuccessful efforts to effect delivery with the forceps.

(b) *Kjelland's forceps*.—This instrument is of light construction and is so designed that it can be used for the purpose of rotation of the foetal skull, in addition to the application of traction. The pelvic curve of the shank has been abolished and the lock allows one blade to slide upwards or downwards on the other while maintaining the grip of the blades on the foetal head. In competent and experienced hands the instrument is safe and simple to use and the results consequently are most satisfactory. It is quite unsatisfactory and also dangerous in what may be termed casual use. In other words, no practitioner who has not had extensive postgraduate experience in obstetrics, or who has not been specially instructed in the application and use of the instrument must ever think of attempting rotation of the foetal skull with this, or any other, type of obstetric forceps. The basic principles in the use of Kjelland's forceps can be tabulated as follows :

1. There must exist an indication for assistance being necessary in the second stage of labour because of :
 - (a) No progress in spite of good uterine contractions.
 - (b) Maternal distress.
 - (c) Foetal distress.
2. Pelvic examination shows :
 - (a) Arrest of the foetal skull in the cavity of the pelvis.
 - (b) The occiput is lying directly posterior, obliquely posterior, or even in the transverse diameter. (The last position is known as deep transverse arrest and is considered later.)
 - (c) There is no reason to believe that vaginal delivery cannot be successfully accomplished after correction of the position of the head to the occipito-anterior position.
3. The instrument is applied correctly and accurately to the foetal head no matter in what position the head lies in the pelvis. An accurate application is of supreme importance.
4. Rotation of the foetal head is obtained by the use of gentle efforts in the correct direction until from the position of the instrument the occiput is known to be anterior.
5. Traction is applied and the birth of the baby effected.

3. *Persistent Occipito-Posterior Position—Arrest at the Pelvic Outlet*

If it is found that arrest has occurred when the head is so low in the pelvic cavity that with each contraction of the uterus the foetal scalp is easily visible, it is probable that further progress is being prevented by the muscles of the pelvic floor. To reach this level the foetal head will already have undergone a variable amount of moulding for the persistent

posterior position of the occiput (see Fig. 96). Rotation of the occiput to the front in this case, however it is accomplished, with the relatively rapid and consequent alteration of the moulding is positively dangerous. The correct treatment, therefore, is to perform an episiotomy and to assist the delivery of the baby with the head in the unrotated occipito-posterior position. A large diameter, albeit shortened by moulding, will have to pass through the pelvic floor and therefore the episiotomy should be adequate. Traction with the obstetric forceps must be careful and only moderate force should be used. The instrument was not designed to fit the head in this position and may slip off. Only moderate traction however is necessary to complete the delivery of a foetal head which is arrested by the perineal muscles at this very low level.

Very occasionally arrest at this level is the result of pelvic contraction in the lowest part of the pelvic outlet, perhaps associated with narrowing of the subpubic arch.

This state of affairs ought to have been diagnosed at an examination of the patient in pregnancy or at least at some earlier stage in labour. If this had been done a decision might have been made as to the advisability of delivery by Cæsarean section. When arrest has occurred at this late stage steps have to be taken to complete the delivery of the baby.

It is probable that the foetal head has undergone a gross degree of moulding and that that portion of the foetal scalp which is visible at the vaginal outlet during a contraction of the uterus covers a large and perhaps enormous caput succedaneum. In consequence an extensive vaginal examination is unlikely to be possible, and indeed is likely to be fraught with danger. Any upward displacement of the foetal head could only be accomplished by the use of forcible pressure and might cause rupture of the uterus.

Probably the best plan, especially if the foetus is alive, is to attempt to effect delivery by traction with the obstetric forceps. An accurate application of the instrument to the foetal head is not possible, because, for reasons already given, the exact position of the head cannot be determined. Traction must be cautious, as the grip of the instrument on the head is not likely to be secure. Failure to effect delivery from below, even following the application of forceps and even when a long period has elapsed after rupture of the membranes, would, by some authorities, be treated by Cæsarean section. The upward displacement of the foetal head at the time of operation is likely to be extremely difficult.

If the foetus is dead and if infection, indicated by the presence of an offensive discharge, is present craniotomy should be performed.

Deep Transverse Arrest

This term denotes arrest in labour when examination shows that the foetal head has descended to the level of the ischial spines and that the sagittal suture lies in the transverse diameter of the pelvis. The occiput is on one side of the pelvis and the synciput on the other ; flexion of the head is deficient. The condition would only be diagnosed in the second stage of labour. Unlike the persistent occipito-posterior position in which birth of the baby often occurs face to pubes deep transverse arrest is an invariable cause of obstructed labour.

Cause.—In many cases the position of the foetal head at the onset of labour is posterior. During labour the long anterior rotation of the occiput is arrested so that the sagittal suture remains in the transverse diameter of the pelvis. The level of arrest is at the level of the spinous processes of the ischial bones. These processes in many cases have been found to be unduly prominent and for that reason the suggestion has been made that they contribute to the malposition. Be this as it may, deep transverse arrest is very apt to recur in subsequent labours and for this reason the true causative factor almost certainly is to be found in deformity of the bony pelvis in which there is narrowing and slight contraction at the lower levels. The android type of pelvis is the most likely deformity to produce deep transverse arrest.

Diagnosis.—The diagnosis is made on vaginal examination during the second stage of labour. The vaginal examination is usually necessitated because the progress of labour has ceased, or because there are signs of maternal or foetal distress. The findings on vaginal examination have already been outlined and can be listed as follows:

1. Arrest occurs at the level of the ischial spines.
2. The ischial spines may be easily felt.
3. The sagittal suture lies in the transverse axis of the pelvis.
4. Both fontanelles may be palpable indicating deficient flexion of the head.
5. Overlap of foetal cranial bones may be felt.
6. The caput succedaneum may be pronounced.

Management.—When this state of affairs is found it is necessary to take steps to assist delivery. Rotation of the foetal head must be effected so that the occiput comes to the front and then and then only is the forceps applied. Rotation may be done manually or with the Kjelland's forceps. Exactly the same procedure is followed, and exactly the same precautions are necessary as have already been described

in detail when rotation of the head is necessary from the occipito-posterior position. Vaginal examination, usually made under anæsthesia, and when necessary after an episiotomy has been performed, has accurately determined the exact position of the head in the pelvis. Fontanelles have been identified and from their position the position of the occiput determined. Confirmation of the position of the head is often obtained by the search for an ear and noting the direction in which the helix points. The right hand is passed into the vagina and the head is grasped by the thumb on the occiput and the fingers on the forehead. The foetal head is then rotated to an occipito-anterior position. As in the case of the occipito-posterior position this rotation can often be successful with the use of the half hand only. Following successful rotation the obstetric forceps is applied and the baby delivered.

In a neglected case the foetal head may be found to have been driven down to a lower level and to appear almost to be wedged in the pelvic cavity. Rotation in this case will be made easier if the forehead is pushed upwards so as to disimpact and slightly flex the head. Whenever the head is being rotated the left hand should assist the concurrent rotation of the shoulders by pressure through the abdominal wall. Very rarely indeed all attempts at rotation fail. This is probably due to true impaction of the foetal head in the pelvic cavity. If this has occurred the foetus will certainly be dead and the safest procedure is to perform craniotomy. The slightest decrease in the size of the foetal head usually allows its subsequent extraction with the obstetric forceps without difficulty.

Failure to relieve the condition of obstructed labour, whatever the cause, in England and Wales is an indication for seeking help from the obstetric emergency team. Kjelland's forceps are specially designed and ideally constructed to rotate the head in a case of deep transverse arrest, but the advice is repeated that their use should be limited to those who are familiar with the instrument. Note is made that in this malposition accurate application of the forceps to the foetal head is even more difficult, and therefore in unskilled hands correspondingly more dangerous, as compared with its application to the head in the occipito-posterior position.

The ordinary obstetric forceps should never be used for rotation of the head, as severe laceration of the vagina and injury to the head will be caused.

FACE PRESENTATION

Face presentation, in which the head is fully extended, occurs about once in 300 labours, and is slightly more frequent in multiparæ than in

primigravidæ. It is either primary or secondary. The latter is very much more common than the former

Primary face presentation means that the fœtus is presenting by the face before labour begins

Secondary face presentation means that the head becomes fully extended during labour

CAUSE

Primary face presentation is due to such rare fœtal deformities as anencephaly and congenital tumours of the neck.

Secondary face presentation is the most common type.

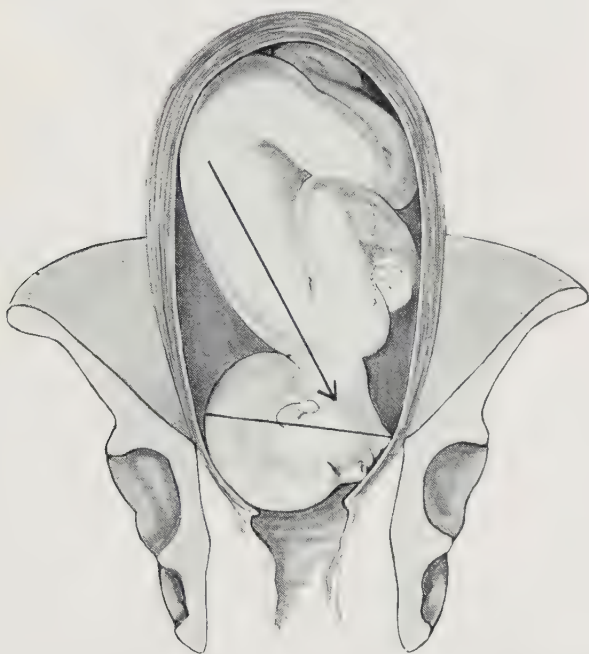


FIG. 98.—PRODUCTION OF FACE PRESENTATION IN A FLAT PELVIS.

Extension occurs because the wide biparietal diameter is arrested. Once sufficient extension is present to get the occipito-spinal joint in front of the axis of the uterus, the uterine force, shown by the arrow, tends to increase the extension and cause the face to present.

Face presentation may be associated with marked uterine obliquity as seen in pendulous abdomen in multiparæ. Fœtal deformities such as anencephaly or congenital tumours of the neck will usually cause this presentation. Intra-uterine death of the fœtus by loss of muscle tone will result in a proportion of cases of face presentation. It may

occur under any of the conditions which prevent easy engagement of the foetus such as a flat pelvis in which the wider biparietal diameter tends to become fixed. Once the head is deflexed, as may be the case with an occipito-posterior position, uterine contractions may increase extension and thus cause a brow or face presentation.

Lastly the normal attitude of flexion of the foetus may be absent and increased extensor tone may exist and be a direct cause of this malrepresentation.

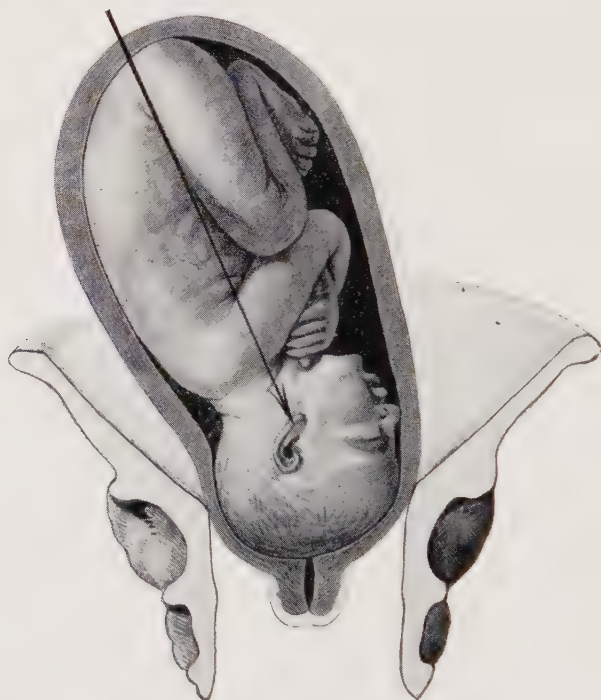


FIG. 99.—PRODUCTION OF A FACE PRESENTATION BY OBLIQUITY OF THE UTERUS.

The line of uterine force tends to push the occipito-spinal joint in the direction of the face and so causes extension of the head when the foetal back is to the right.

Positions.—The chin is the denominator and four positions are described, analogous to the corresponding positions of the vertex from which they arise.

1. Right mento-posterior (R.M.P.) (Figs. 100 and 101).
2. Left mento-posterior (L.M.P.).
3. Left mento-anterior (L.M.A.) (Fig. 102).
4. Right mento-anterior (R.M.A.).

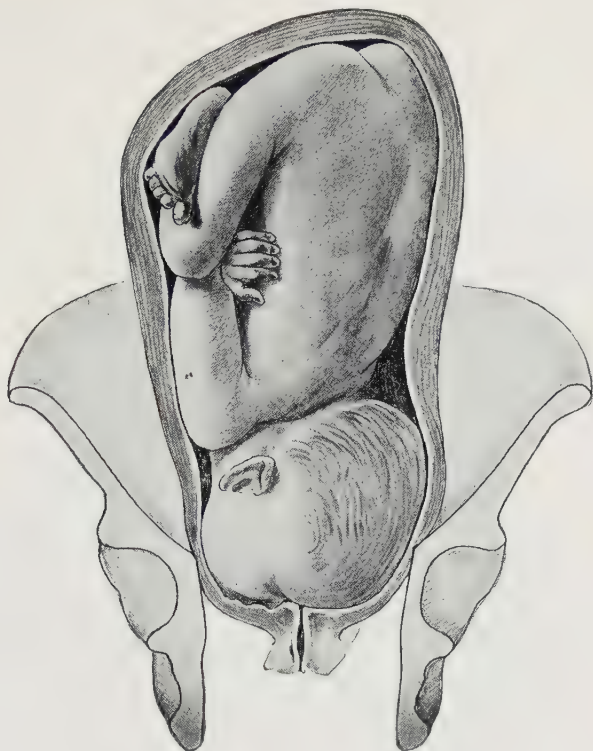


FIG. 100.—FACE PRESENTATION: FIRST POSITION, R.M.P.

The face from the chin to the bregma presents, the submento-bregmatic diameter occupying the right oblique diameter of the pelvic inlet. The back faces forward and to the left, but is extended instead of flexed as in a vertex presentation, so that the breech is more prominent and more easily palpated.



FIG. 101.—FACE PRESENTATION. FIRST POSITION, RIGHT MENTO-POSTERIOR.

The third and fourth positions are relatively more frequent because of their origin from occipito-posterior presentations, in which deflexion is more likely to occur.

MECHANISM

The mechanism of face delivery differs from that of the vertex in that extension occurs instead of flexion. In a mento-anterior (third or fourth position) the face engages and descends with increasing extension, so that the submento-bregmatic diameter (9.3 cm., $3\frac{3}{4}$ in.) comes through the cervix, instead of the submento-vertical (11.2 cm., $4\frac{1}{2}$ in.). When

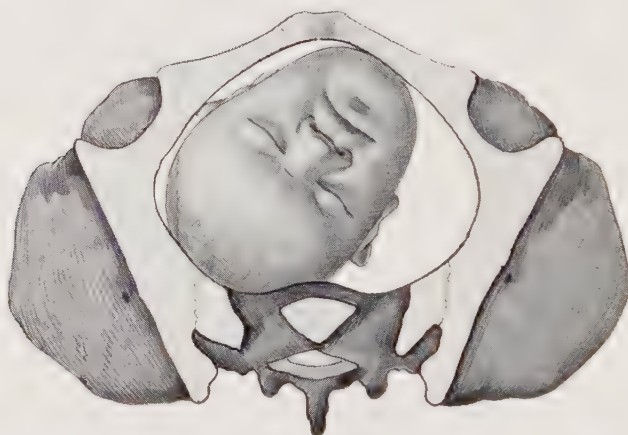


FIG. 102.—FACE PRESENTATION. THIRD POSITION, LEFT MENTO-ANTERIOR.

the face reaches the pelvic floor it undergoes internal rotation through one-eighth of a circle, and the submental region comes to lie under the pubic arch. The head is then born by a movement of flexion, the submento-vertical diameter distending the vulva (Fig. 105). Restitution occurs and is followed by external rotation as in vertex presentations.

In a mento-posterior (first or second position), the same mechanism occurs, except that the chin has to undergo internal rotation through three-eighths of a circle (Figs. 103 and 104). Backward rotation of the chin, the persistent mento-posterior, is not common, but it cannot be delivered as such, unless the foetus is extremely small. This is because the head is already fully extended, and further extension to deliver the head through the outlet is quite impossible. The head and shoulders become impacted in the pelvis, and obstructed labour will occur unless assistance is given.

Moulding.—In a face presentation the submento-vertical diameter of the head is compressed, causing elongation of the occipito-frontal



FIG. 103.—FACE PRESENTATION. MECHANISM IN THE FIRST POSITION (R.M.P.).

The head descends with extreme extension, so that the chin is in advance. Internal rotation of the chin forwards now occurs.

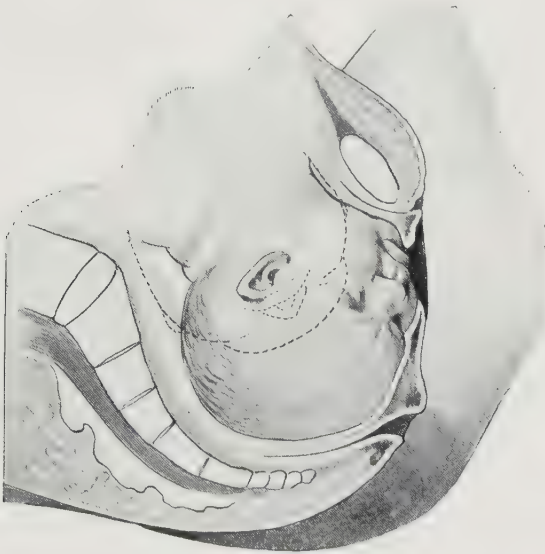


FIG. 104.—FACE PRESENTATION. MECHANISM IN FIRST POSITION (R.M.P.).

Internal rotation of the chin almost complete. The chin has rotated from the right side of the pelvis, as indicated by the dotted lines, to under the pubic arch, so that the submento-bregmatic diameter is nearly in the antero-posterior diameter at the pelvic outlet.

diameter (Fig. 106). This shape of head is called dolicho-cephaly, and in some animals is a cause of face presentation.

DIAGNOSIS

Abdominal Examination.—In a mento-posterior, the cephalic prominence is very readily felt and appears to overlap the symphysis pubis; it is felt on the same side as the back, from which it is separated by a deep sulcus. It is indeed difficult to feel the upper part of the back, while the podalic end is unduly prominent. The foetal heart may be indistinct and difficult to locate.



FIG. 105.—FACE PRESENTATION. BIRTH OF THE FACE.

Internal rotation has occurred, bringing the chin under the pubic arch. The head now escapes by a movement of flexion, its submento-bregmatic and then submento-vertical diameters in turn distending the vulva.

In a mento-anterior, the cephalic prominence is again felt on the same side as the back, but the latter, being posterior, is difficult to feel, and the very prominent chest may be mistaken for it, thus leading to a mistaken diagnosis of a flexed vertex. The foetal heart is easily heard over the chest, and an important diagnostic point is the finding of small parts on this same side (Fig. 107). X-rays will settle the diagnosis in a doubtful case.

Vaginal Examination.—Early in labour it may be difficult to reach the presenting part. As the face is more irregular than the

vertex, the bag of membranes tends to elongate and rupture early. When the presenting part has engaged in the brim and can be explored by the finger, the point of the chin, the mouth and nose, and the bony orbital margins will be recognizable. Care should be taken not to



FIG. 106.—MOULDING IN FACE PRESENTATION.

The arrows indicate the direction of the pressure which shortens the diameter between the submento-vertical and submento-bregmatic diameters. The splitting of the skin in the front of the neck and the swelling of the face are also shown.



FIG. 107.—FACE PRESENTATION. TO SHOW FINDINGS ON ABDOMINAL EXAMINATION.

In mento-posterior positions, the marked prominence of the occiput will be found on the same side as the back. Above this an interval may be detected before the back is felt running up into the unduly prominent breech.

In mento-anterior positions the small parts are very distinctly felt owing to the way they are thrust forward towards the abdominal wall. On auscultation the heart-sounds may be heard most plainly on the same side as the small parts are felt.

injure the eyes when palpating the face. When a caput succedaneum has formed the face may be confused with a breech. This mistake should not be made if the abdomen has been examined, and furthermore the mouth can be identified by the presence of the alveolar ridges.

If in doubt, a finger should be passed round the side of the presenting part to feel for an ear. The diagnosis of position is made by noting the direction of the chin.

PROGNOSIS

Many face presentations are delivered naturally and without the slightest difficulty. On the other hand, the causes determining the face presentation sometimes affect the outlook for both mother and child, especially in cases of disproportion at the pelvic brim. Apart from this, face presentations are somewhat less favourable than vertex presentations, because of a greater tendency to early rupture of the membranes and to uterine inertia, because the face is a less efficient dilator of the cervix than the vertex.

The emerging diameter, submento-vertical (11.2 cm. $4\frac{1}{2}$ inches), is larger than in the normal vertex. With the mento-posterior positions the prognosis for both mother and child is less favourable than when the chin is in front, because of the delay and resulting obstruction necessitating intervention if forward rotation does not occur.

MANAGEMENT OF LABOUR

In the majority of cases, especially in multiparæ, spontaneous delivery can be expected.

The patient must be kept in bed during the first stage, and a vaginal examination made as soon as the membranes rupture, to exclude prolapse of the cord. Attempts to convert the face into a vertex are unwise, as a brow presentation may result, but uterine obliquity should be corrected by putting the patient on her left side. Assistance with forceps may be necessary in a mento-anterior if the face is delayed at the outlet.

Infiltration of the perineum with 1 per cent. novocain and episiotomy are advisable in primiparæ if there is any undue delay when the presenting part has reached the pelvic floor.

Cæsarean section for face presentation is necessary only when there is a complication, such as contracted pelvis or prolapse of the cord.

In a mento-posterior time should be allowed for spontaneous rotation, but assistance must be given at once if arrest occurs. Under anæsthesia, the head is rotated manually to bring the chin in front (Fig. 108), after which the forceps is applied and delivery completed.

The face is always somewhat swollen and discoloured after a face delivery and the parents should be warned that it is temporarily unsightly (Fig. 109). If the foetus is dead, the head should be perforated through the forehead or orbit to allow easy delivery.



FIG. 108.—PERSISTENT MENTO-POSTERIOR POSITION.

Manual rotation of the face to bring the chin forwards with rotation of the body by pushing over the anterior shoulder. Before attempting this the head is pushed up to allow of free movement of the face.



FIG. 109.—APPEARANCE OF THE FACE AFTER DELIVERY IN A FACE PRESENTATION.

BROW PRESENTATION

As a rare occurrence the head may try to enter the pelvis midway between flexion and extension, so that the brow presents. The causes are the same as those which lead to the production of secondary face presentations, contracted pelvis and marked uterine obliquity being important. Quite frequently and especially if the foetus is small the



FIG. 110.—BROW PRESENTATION.

The head is above the brim and not engaged. The mento-vertical diameter of the head is trying to engage in the transverse diameter at the brim (compare Fig. 131, in which moulding has occurred).

poor flexion associated with occipito-posterior position may become diminished and at the onset of labour slight added extension result in the production of a brow presentation.

All face presentations must pass through this stage, but a persistent brow is fortunately rare. The head lies with its longest diameter, the mento-vertical (13.1 cm., 5¼ in.) across the pelvic brim, and only an

exceptionally small foetal head will engage in an average pelvis. With a foetus of average size obstructed labour will therefore result and there is ordinarily no mechanism to describe (Fig. 110).

Strong uterine action will cause marked moulding of the head, compressing the mento-vertical diameter and lengthening the occipito-frontal (Fig. 111). When the foetal head is very small in proportion to the pelvis and is partly extended, it may be driven down into the pelvic cavity and may actually be born as a brow.

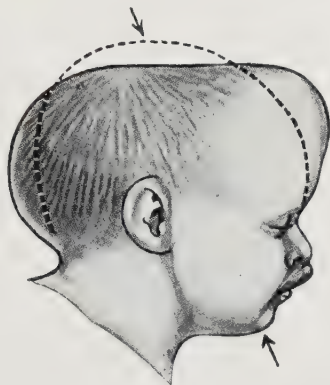


FIG. 111.—MOULDING IN BROW PRESENTATION.

The arrows indicate the direction of the pressure which shortens the vertico-mental and lengthens the occipito-frontal diameters.

DIAGNOSIS

The diagnosis is usually difficult. On abdominal examination the head is above the brim, with definite overlap, and the cephalic prominence is on the same side as the back. This malrepresentation should always be suspected when non-engagement of the head is noted early in labour.

On vaginal examination the presenting part will be high, and as a rule the bag of membranes ruptures early. The examining finger generally touches the middle of the frontal suture; if this is followed in one direction the anterior fontanelle will be identified, and in the other direction the root of the nose and orbital ridges will be found (Fig. 112).

MANAGEMENT

A careful investigation should be made to determine the cause leading to extension of the head, and especially to decide whether there is any pelvic contraction. Even a minor degree will justify Cæsarean section, if the child is alive and other conditions favourable.



FIG. 112.—BROW PRESENTATION.

On vaginal examination the finger usually touches the middle of the frontal suture marked x.



FIG. 113.—METHOD OF ATTEMPTING THE CONVERSION OF A BROW INTO A VERTEX PRESENTATION.

The internal fingers push up the forehead while the external fingers push down the occiput.

If delivery *per vaginam* is decided upon, because, for instance, the patient has previously been delivered of normal babies without difficulty, because the foetus is small and there is no evidence of hydrocephaly, the attitude of the head must be altered so soon as the cervix is sufficiently dilated to admit the hand. An anæsthetic is necessary. First, an attempt should be made to convert the brow to a vertex presentation by flexing the head (Fig. 113). If the position can be corrected by pushing up the forehead, flexion should be maintained by suprapubic pressure on the head, and the vertex then pushed down into the brim.

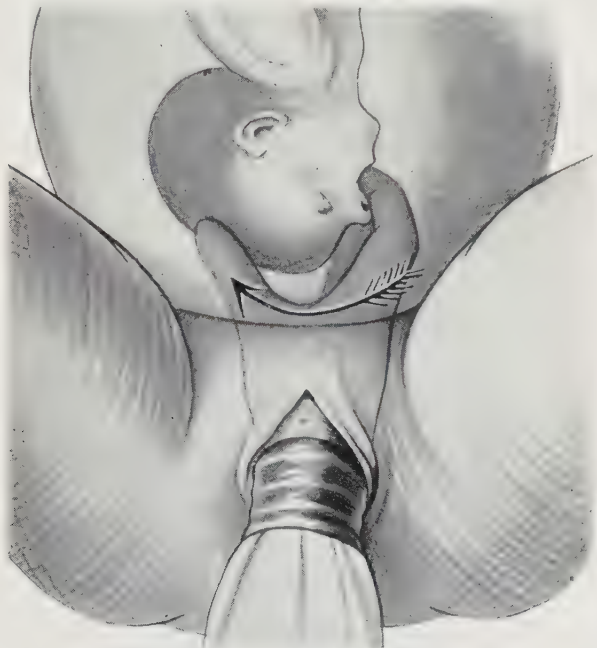


FIG. 114.—METHOD OF ATTEMPTING THE CONVERSION OF A BROW INTO A FACE PRESENTATION.

The whole hand is passed into the vagina and the face brought down by a finger in the mouth, while the forehead and vertex are pushed up by the thumb. Once the face has been brought down, the finger can be put over the point of the chin to hook that down.

If attempts at flexion fail, it should be converted to a face presentation by extending the head. This is done by inserting a finger into the mouth of the foetus, and pushing up the brow with the thumb (Fig. 114). The head should then be pushed into the pelvis if the chin is in front, and delivery completed by application of the obstetric forceps. If the cervix is fully dilated and the chin posterior manual rotation of the head to the mento-anterior position is necessary before the application of the forceps.

If the head cannot be made to engage after either flexion or extension, some degree of disproportion is probably present, and a lower segment Cæsarean section should be performed.

PROGNOSIS

The prognosis is bad for the child, and the risks of sepsis and injury are naturally greater for the mother in view of the internal manipulations which may be necessary to effect delivery. In a neglected case of persistent mento-posterior position in which impaction has occurred any internal manipulation may result in rupture of the uterus. Should attempts at internal rotation prove unsuccessful it is probable that the foetus may be firmly gripped by a uterus that is tonically contracted. The foetus will be dead and delivery can only be effected following perforation of the head (see Chap. XL).

CHAPTER XXX

BREECH AND SHOULDER PRESENTATIONS

BREECH PRESENTATION

Breech presentation occurs in about 3 per cent. of labours, but breech presentation is found more commonly than this before term, in about 25 per cent. of pregnancies at the 30th week, and the incidence is therefore higher in premature births. Spontaneous version occurs in a large number of breech presentations by the 34th week.

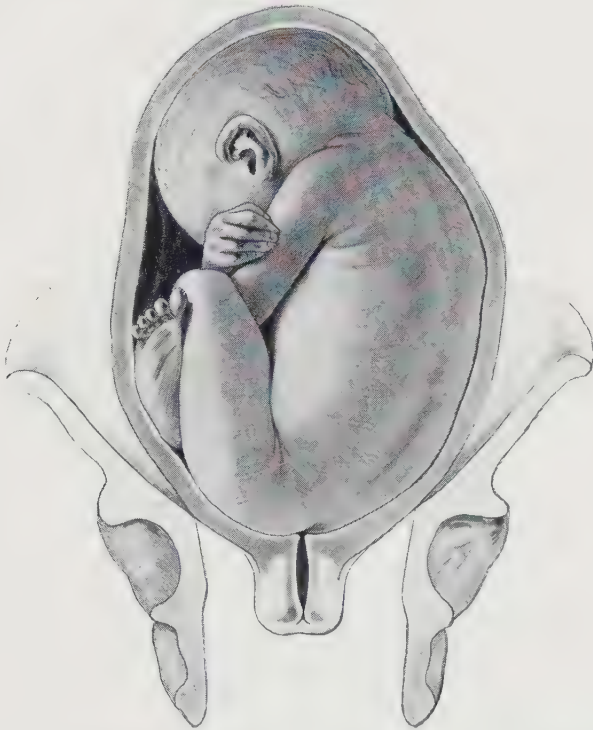


FIG. 115.—BREECH PRESENTATION WITH FLEXION OF THE LEGS.

There are two kinds of breech presentation; one in which the knee-joints are flexed, the other in which they are extended.

1. *The breech with flexion of the legs*, when the breech presents with the knees and hips flexed, so that the feet are near the buttocks (Fig.

115). This used to be called the complete breech. This type is more common in multiparæ. Prolapse of a leg will result in either a *knee* or *footling* presentation.

2. *The breech with extension of the legs*, usually found in primigravidæ, in which the legs are flexed at the hips but extended at the knees, so that the feet lie somewhere in the fundus of the uterus (Fig. 116). This used to be called the incomplete breech.



FIG. 116.—BREECH PRESENTATION WITH EXTENSION OF THE LEGS.

Extension of the arms above the head may occur whether the legs are flexed or extended, but is more common when they are extended.

CAUSATION

Maternal Causes

- (a) Laxity of uterine and abdominal musculature.
- (b) Contraction of the brim of the pelvis.
- (c) Pelvic tumours.

Fœtal Causes

- (a) Prematurity.
- (b) Multiple pregnancy.
- (c) Congenital deformity, especially hydrocephalus.
- (d) Hydramnios.
- (e) Placenta prævia.

Having presented the above table it is immediately necessary to repeat a statement which has already been made to the effect that in many, if not in most, instances of breech presentation no cause is apparent. The most thorough examinations made during pregnancy or after delivery frequently show both mother and baby to be normal. Nevertheless the finding of a breech presentation at an antenatal examination must always be regarded as a physical sign of some underlying and possibly serious causative condition. The fact that the fœtus is much more likely to present by the breech at the 30th week of pregnancy than at term should be appreciated because it signifies the likelihood that spontaneous version will occur and this will have a practical bearing upon the problem of correction by external cephalic version. Breech presentation is more commonly found some weeks before the end of pregnancy because there is relatively more liquor amnii within the uterus and therefore less reason for the fœtus to adopt any particular lie, position or presentation. For exactly the same reasons great laxity of the abdominal and uterine musculature, associated usually with multiparity, is likely to be accompanied by a higher incidence of malpresentation of the fœtus.

It is not uncommon of one, sometimes both, fœtuses to present by the breech in twin pregnancy.

If for any reason the fœtal head does not engage in the pelvic brim during the last weeks of pregnancy, there is a greater chance that the breech will present. Engagement of the fœtal head is prevented by a fairly gross deformity or contraction of the brim of the pelvis, by the presence in the pelvis of an ovarian cyst, fibromyoma or other tumour, by placenta prævia or, very rarely, by hydrocephalus. All these conditions, with the occasional exception of placenta prævia, should have been detected during pregnancy and long before the onset of labour. Not infrequently, therefore, the initial finding of a breech presentation, indicating the necessity of a thorough examination, has led to the discovery of a serious causative abnormality.

Positions of the Breech.—The four positions of the breech are :—

1. Left sacro-anterior (L.S.A.) (Fig. 117).
2. Right sacro-anterior (R.S.A.).

3. Right sacro-posterior (R.S.P.) (Fig. 118).

4. Left sacro-posterior (L.S.P.).

THE DIAGNOSIS OF BREECH PRESENTATION

(a) *During Pregnancy.* The diagnosis is made during pregnancy, and in labour before the rupture of the membranes, by abdominal

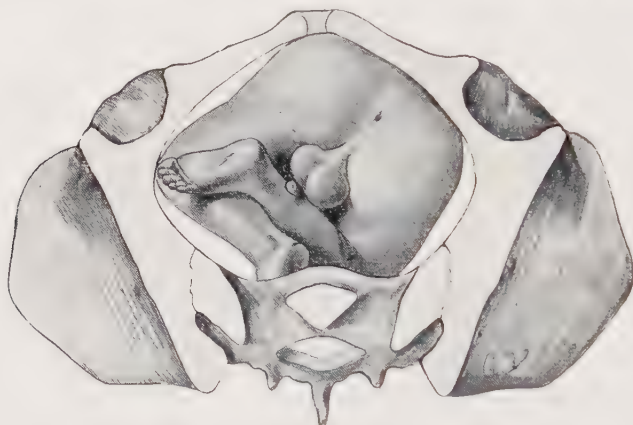


FIG. 117.—BREECH PRESENTATION: FIRST POSITION (L.S.A.).

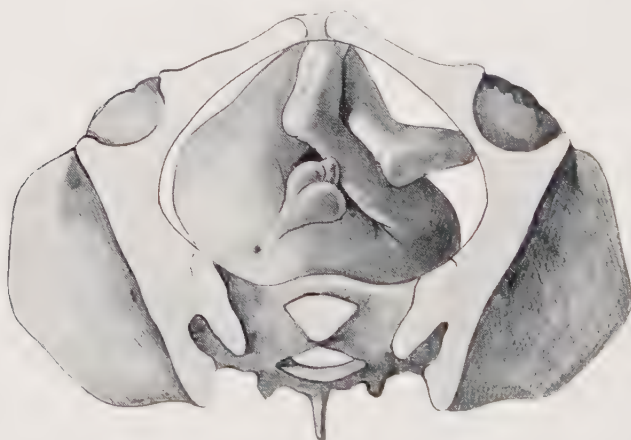


FIG. 118.—BREECH PRESENTATION: THIRD POSITION (R.S.P.).

examination. When the breech presents examination of the lower pole of the uterus fails to demonstrate the presence of the hard foetal skull. Mid-abdominal examination shows the position of the foetal back. The foetal head is felt as a hard, spherical and easily movable object, in the fundus uteri and frequently the patient herself may state

that she has noticed considerable discomfort in this region. Admittedly the breech of a mature foetus may feel hard or firm, but it is never so movable as is the head. When the uterus contains a considerable amount of liquor amnii the foetal head can be ballotted from side to side. The foetal heart is usually best heard at a higher level than is the case in a cephalic presentation. The point of maximal intensity is at the level of or slightly above the umbilicus, but this sign is not absolutely reliable.

Occasionally, perhaps owing to the thickness of the abdominal wall, the diagnosis is extremely difficult and if this should be the case, X-ray examination should be considered.

(b) *In Labour*.—After rupture of the membranes additional information can be obtained from the findings obtained by vaginal examination. In the breech with flexion of the legs a foot may present and easily be felt. This must be diagnosed from a hand. In the incomplete breech superficial examination may mistake the buttock for the foetal skull but the hardness of bone is absent. The anterior buttock is felt first and is separated from the posterior buttock by the anal cleft and genital organs. Three bony landmarks should be identified to determine the position; the ischial tuberosities on either side of the anus and the sacrum behind. The absence of the feet and legs will confirm the diagnosis of extension of the legs. The breech is sometimes confused with a face or shoulder presentation on vaginal examination, particularly if the parts are oedematous. The presence of the alveolar ridges in the mouth distinguish it from the anus. If the examining finger is passed into the anus it will be gripped by the anal sphincter. Ribs can be felt in a shoulder presentation. In a footling presentation the foot is identified by the heel and by the fact that the great toe cannot be abducted to the same extent as the thumb.

Flexion or extension of the legs

Flexion and extension of the legs occur with equal frequency in primigravidae and multiparae. The chief point of practical importance of extension of the legs is that it makes spontaneous version to a vertex presentation much less likely. If this be true, as it probably is, then extension of the legs is likely to provide an added difficulty to successful external cephalic version.

It was believed that extension of the legs provided a complicating factor to the descent of the foetus down the birth-canal. During descent lateral flexion of the foetus must occur and it was thought that the presence of the extended legs acted as a splint which prevented such lateral flexion. Either this hypothesis was incorrect, or by a better understanding of the correct management of breech delivery, the

supposed dangers of extension of the legs have been proved to be non-existent. Indeed, the incomplete breech appears to be an excellent presenting part, and to be as efficient as, if not more efficient than, the vertex, in the manner in which it assists in the dilatation of the cervix.

PROGNOSIS

The foetal mortality is higher in breech than in vertex presentation even if complications such as pelvic contraction, placenta prævia and foetal abnormalities, especially prematurity, are excluded. In the past the foetal mortality has been stated to be 10, 15 per cent. and even as high as 25 per cent. In recent years, however, a much lower rate obtains in the majority of obstetric units and several large series of breech births have been reported with a foetal mortality of between 1 and 3 per cent.

The three reasons for a raised perinatal foetal mortality are:

1. Prematurity
2. Intracranial injury
3. Death of the foetus from anoxia

1. *Prematurity*.—The explanation for the increased proportion of breech births in premature labour has already been given. Often the size of the foetus increases with increasing parity.

Taking into account the three causes of perinatal mortality mentioned above, together with the association of breech presentation with other complicating factors the following conclusions have proved to be fully justified.

- (a) There is no place for agreeing to the confinement of a woman with a breech presentation elsewhere than in hospital.
- (b) The delivery of the baby must be in the hands of someone, be it practitioner or midwife, who is thoroughly experienced in the care and management of this abnormal presentation.

The considerable improvement in the perinatal mortality which has taken place is undoubtedly due to a gradual acceptance of these two recommendations.

2. *Intracranial injury*.—The risk of tentorial tear and cerebral hæmorrhage is greater with an aftercoming head. Less time is available for moulding to occur, and rapid compression of a badly flexed head is particularly likely to produce this injury. This cause of death accounts for 75 per cent. of foetal perinatal mortality in breech delivery.

3. *Interference with the placental respiration* is more liable to occur. It results from compression of the umbilical cord by the aftercoming head, and also from uterine retraction which may cause separation of the placenta before the birth of the head. Delay in the delivery of the head for more than 10 minutes after the body has been born is very likely to endanger the baby's life by asphyxia.

Breech birth is particularly dangerous in the presence of even slight disproportion between the bony pelvis and the foetal head. Pelvic contraction should have been suspected, and diagnosed, at prenatal examinations. If in a primigravida a breech presentation persists every effort should be made, including X-ray pelvimetry, to prove the normal size and structure of the pelvis, before the onset of labour. Multiparity, the previous confinements having been normal and easy, should certainly not indicate complete freedom from anxiety in the birth of a subsequent baby presenting as a breech. A large foetus can cause disproportion just as readily as can a slightly contracted pelvis and often the foetus increases in size with increasing parity.

External Cephalic Version. Because of the high foetal mortality, in breech delivery it is now recognized that if the foetus is presenting by the breech it should be turned by external cephalic version into a cephalic presentation. In primigravidæ version is particularly desirable. It is usually possible to determine those cases in which it is likely to be possible. Thus it is useless to attempt it if the amount of liquor amnii appears to be small and if the foetus seems to fill a uterus the muscular wall of which is tense.

Other contra-indications to version are:—

1. Gross pelvic contraction, when Cæsarean section is necessary.
2. Placenta prævia, because of the risk of causing hæmorrhage.

External cephalic version can be attempted at any time in pregnancy at which the diagnosis of breech presentation has been made. Before the 34th week of pregnancy it is doubtful whether the attempt is advisable, or even necessary, because in so large a proportion of cases spontaneous cephalic version is likely to occur. In most women after the 38th week of pregnancy version, owing to the size of the foetus and the relative decrease in the amount of liquor amnii is unlikely to be successful. Version should not be attempted during labour, nor in a case of multiple pregnancy.

It is not advisable to inform the patient; indeed it is better that she should remain in ignorance of the malpresentation. She will nearly always assess its seriousness far too highly and in consequence be

unnecessarily worried. Before version is attempted the exact position of the foetus must be determined and the foetal heart must be heard. Better relaxation of the muscles of the abdominal wall will be obtained if the knees are slightly flexed. The first step in external cephalic version is to disengage the breech from the pelvic brim. This is done by lifting it upward by pressure with the fingers of both hands through the abdominal and uterine walls. The lower part of the uterus is always slightly tender and the patient will resist the use of any undue force. Occasionally the breech cannot be disengaged, in which case no further attempt at external version should be made. When the breech has been lifted out of the pelvis it is held in this position by one hand while the other hand presses on the foetal head in such a direction as to increase the attitude of flexion. Version is usually successful as the result of steady prolonged pressure. Jerky movements should not be made. They will cause pain and the patient will be likely to resist all further efforts.

After successful version the foetal heart must be auscultated once more and an attempt should be made to make the foetal head engage in the pelvic brim. Vaginal bleeding intimates placental detachment.

Anæsthesia should only be considered after attempts at cephalic version have failed in the conscious patient. There are certain objections to the use of anæsthesia, and indeed there are some who doubt whether an anæsthetic should ever be used for external cephalic version. Deep anæsthesia is essential. Version under light anæsthesia can be more difficult than in the conscious patient: the latter can at least try to relax her muscles. The fact that an anæsthetic is necessary worries the woman far more than most practitioners realize. Increased force is very liable to be used when the patient is anæsthetized leading to such untoward events as the onset of labour, detachment of the placenta and intra-uterine death of the foetus probably due to obliteration of the circulation of the umbilical cord which has become twisted round a limb in the process of version. Moreover, the dangers of breech delivery seem to be decreasing steadily and the time has come when each individual practitioner must assess his skill at external cephalic version against his ability safely to conduct the delivery of a foetus presenting by the breech.

It is not possible, therefore, to be dogmatic regarding anæsthesia. If, however, the decision is made to attempt external cephalic version under anæsthesia the only anæsthetic agents that will give the necessary relaxation are ether and chloroform. The former is safe if unpleasant, the latter is dangerous. Modern relaxants do not diminish the tone of the uterine muscle, nor do they abolish uterine contractions. The procedure in version under anæsthesia is identical with that in the

conscious patient, but the operator must always refrain from the use of undue force. Perhaps the greatest advantages of the anæsthetic are



FIG. 119.—EXTERNAL CEPHALIC VERSION.

The breech has been disengaged from the pelvic inlet. Version is first attempted as shown above.



FIG. 120.—EXTERNAL CEPHALIC VERSION.

that it allows the breech to be disengaged by upward pressure from below and that it allows of a very much more thorough pelvic examination to

determine the absence of disproportion after successful version, between the foetal head and the upper part of the pelvis.



FIG. 121.—EXTERNAL CEPHALIC VERSION COMPLETED.



FIG. 122. The foetal heart having been heard attempts are made to ensure the satisfactory engagement of the foetal head into the brim of the pelvis.

Finally, version under anaesthesia should not be considered at all if the quantity of liquor amnii appears to be small or if the foetus appears to be large.

Mechanism of Labour

The bi-trochanteric diameter (10 cm., 4 in.) engages in an oblique diameter of the pelvic brim, usually with the back in front. The breech descends into the pelvic cavity and internal rotation then brings the bi-trochanteric diameter into the sagittal plane of the outlet.

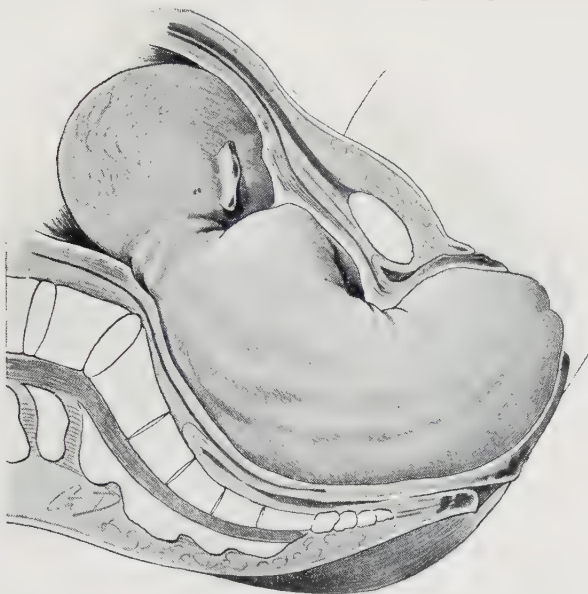


FIG. 123.—LATERAL FLEXION OF THE BODY IN THE THIRD POSITION OF THE BREECH.

The anterior (right) buttock is under the pubic arch, and the posterior (left) is escaping over the perineum. The child's sacrum looks directly to the mother's right side, and the body is flexed round the symphysis. The shoulders are entering the pelvis in the same oblique diameter as that previously occupied by the buttocks, so that there is also a slight twist on the body.

The breech is born by lateral flexion of the trunk, the anterior buttock appearing first (Fig. 123). This movement of lateral flexion is produced by the curve in the birth-canal, and less flexion is necessary with a relaxed or deficient perineum. The delivery may be delayed by a rigid perineum.

The baby's abdomen is born by further descent, and some external rotation may be observed as the bisacromial diameter (11·8 cm., $4\frac{3}{4}$ in.) engages in the oblique diameter of the brim. The anterior shoulder normally emerges first from under the pubic arch, and is quickly followed by the posterior shoulder (Fig. 123). The flexed head engages more or less in the transverse diameter of the brim, and forward rotation of the back will be observed as the head descends into the pelvic cavity and undergoes internal rotation, the occiput coming to lie

behind the symphysis pubis. The neck rests under the pubic arch, and the head is born by a movement of flexion, which can be assisted by lifting the baby's body forwards, and by supra-pubic pressure (Fig. 125). Very occasionally posterior rotation of the occiput occurs and the head is born face to pubes. This mechanism is less favourable as the occipito-frontal diameter distends the vulva.

Management of Labour

First Stage.—It is assumed that before labour starts the diagnosis of a breech presentation has been correctly made and that a thorough examination has failed to demonstrate any abnormality in the pelvic

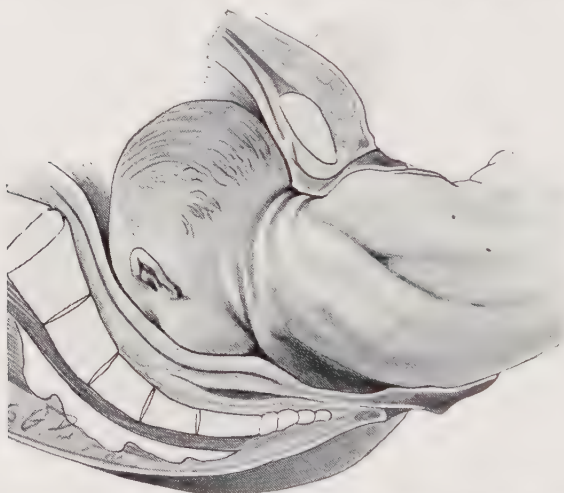


FIG. 124.—ROTATION FORWARDS OF THE OCCIPUT IN THE THIRD POSITION OF THE BREECH.

The anterior shoulder is born, the posterior is on the perineum. Lateral flexion of the body is still present. Rotation of the after-coming head so as to bring the nape of the neck under the pubic arch and the occiput behind the symphysis is occurring.

size or shape, or in the foetus. In these circumstances the conduct of labour is exactly as described in the management of this stage in the case of a vertex presentation. Early rupture of the membranes may occur, as the fit of presenting part is not such as to prevent the membranes being subjected to the full force of each contraction.

As soon as the membranes rupture a vaginal examination should be made to exclude prolapse of the umbilical cord. Prolapse of the cord is more likely to occur in the case of presentation of the frank breech; if the legs are extended the incomplete breech is unlikely to allow descent of the cord. It is doubtful if rupture of the membranes is delayed by keeping the patient lying down. Regular and effective

contractions are more likely to occur if the patient is up during the earlier part of labour. If good progress has been made after twelve hours in a first labour it is unlikely that there will be any difficulty in the subsequent delivery. Throughout this stage of labour a watch is kept, as always, for failure of progress, and for evidence of maternal or foetal distress.

Second Stage of Labour.—Spontaneous delivery of the breech occurs in a large proportion of cases whether the legs be extended or not, especially in parous women. In both primigravidae and multiparæ

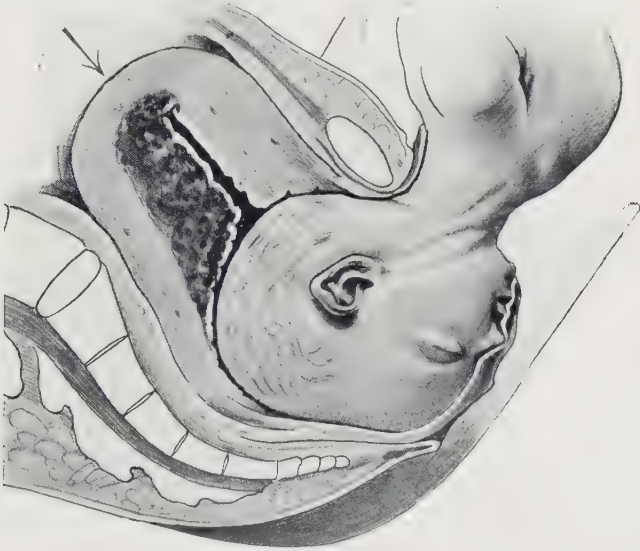


FIG. 125.—BIRTH OF THE AFTER-COMING HEAD.

The nape of the neck is under the symphysis, the chin is escaping over the perineum. In delivery the child's body is carried upwards with its back towards the mother's abdomen, while the hand on the abdomen assists the expulsion of the head by gentle pressure on the fundus in the direction of the arrow.

the second stage is allowed to continue so long as descent of the presenting part is un-interrupted and in the absence of signs of maternal or foetal distress. When the breech reaches the pelvic floor, or if at any time it is necessary to make a pelvic examination to discover the cause of delay, the patient should be placed in the lithotomy position.

In the case of a primigravida nitrous oxide and oxygen or trilene analgesia should be given with each contraction to relieve the pain ; episiotomy should be performed as a routine under local anaesthesia. This is done in order that the intact pelvic floor does not provide any obstacle to the delivery of the breech and to facilitate the ultimate delivery of the foetal head. Routine episiotomy is not necessary in a parous woman.

In the case of the complete breech the feet and legs present and as they appear they are eased out with appropriate digital pressure. If the legs are extended the anterior buttock first becomes visible and is allowed to descend with each contraction (Fig. 126). The minimum of assistance is given by digital traction in the groin (Fig. 127). As the breech is born further assistance may be given by traction in the posterior groin. Traction should only be exerted when the uterus is contracting. Nearly all cases can be delivered by this method for which a general anæsthetic is not necessary.



FIG. 126.—BREECH WITH EXTENDED LEGS.

The breech is smaller than the flexed breech and than the head. It has entered the brim easily, but having descended deeply into the cavity of the pelvis is arrested by the perineum.

As has already been stated progress in labour may be arrested, but very rarely, before the presenting breech has reached the level of the pelvic floor, or in other words, in the cavity of the pelvis. Whatever the presentation, this situation demands an immediate and thorough examination to determine the cause because it is usually due to cephalopelvic disproportion. A satisfactory examination can only be made if the patient is anæsthetized.

If it is considered that the degree of pelvic contraction is such as to provide inevitable and great difficulty in the subsequent extraction of the child, delivery by Cæsarean section should be performed. Should, however, a decision be reached that no such obstacle exists and that with assistance successful delivery *per vaginam* ought to be possible the following procedure must be adopted.

After anæsthetizing the patient a hand is inserted into the vagina alongside the extended legs. The breech may have to be pushed up a

little to enable the whole hand to be inserted. The anterior leg is brought down first, by pressing into the bend of the knee and abducting the thigh. Aided by abdominal manipulations with the other hand, the knee will flex and the foot can be grasped and brought down. The posterior leg can now be brought down in a similar manner, and delivery proceeded with. Unless each leg is first flexed, pulling on the knee may fracture the baby's femur.

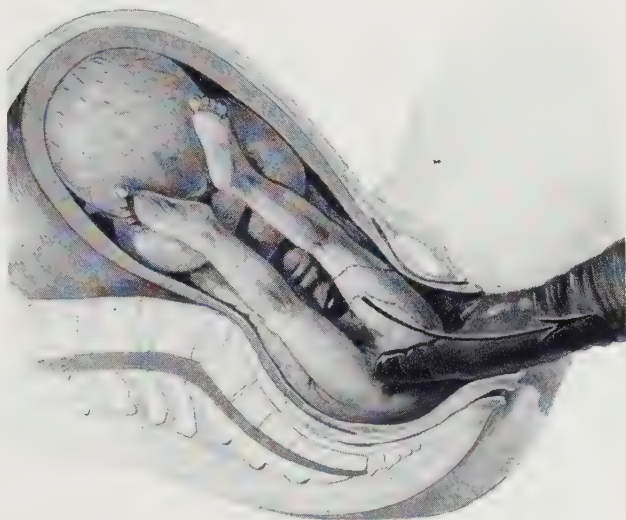


FIG. 127.—TRACTION OF THE ANTERIOR GROIN IN A SACRO-POSTERIOR POSITION OF THE BREECH WITH EXTENDED LEGS.

The breech has descended deeply into the pelvis so traction with a finger in the groin completes the delivery usually after an episiotomy has been performed.

Breech extraction at an earlier stage of labour, before the cervix is fully dilated, is attended by a higher foetal mortality. The undilated cervix tightly grips the body of the child. As the baby is extracted the cervix prevents descent of the arms which inevitably become extended. The difficulties of extraction of the deflexed foetal head through an undilated cervix are obvious and efforts made to provide assistance are most likely to produce severe cervical lacerations. It may very occasionally be necessary to assist delivery before complete dilatation of the cervix on account of foetal distress, if, for example, the cord has prolapsed and become compressed.

Whether the breech has been delivered spontaneously or with assistance, the pulsation of the cord must be observed to determine the condition of the child since this will influence the further conduct of the labour.

A finger should now be inserted into the vagina to make certain that the arms are lying folded on the chest. As delivery of the shoulders proceeds the baby's body should be allowed to hang downwards, in order to produce flexion of the head on the neck and to exert slight traction in the direction of the pelvic axis. As soon as the head has descended on to the pelvic floor and the nape of the neck can be seen below the pubic arch, the baby's legs should be firmly grasped just above the ankles and by exerting slight traction, the baby's body is lifted upwards towards the mother's abdomen. The face will then appear at the vulva and, as the baby can now breathe, the head can be delivered slowly and carefully. It is most important to realize that lifting the baby's body upwards before the head has passed completely through the brim, will not assist delivery, and may injure the cervical spine.

Extension of the Arms.—Spontaneous delivery will not occur in cases of extension of the arms unless the foetus is extremely small, and assistance must be given as soon as the diagnosis has been made. Extension of the arms should be suspected if descent of the foetus is not continuous after the delivery of the thorax and if examination shows the absence of the arms from the pelvic cavity. This complication must be dealt with at once as extension of the arms will prevent the completion of delivery at a most critical moment. There are two methods that can be employed to deliver extended arms, that described by Lövset and the so-called classical method. The former is the method of choice as it is most effective and involves no intrapelvic manipulations which will lessen the risk of injury to the mother or foetus. The principle of Lövset's manœuvre is based on the knowledge that as the result of the curvature of the birth-canal the posterior shoulder must be at a lower level than the anterior shoulder. Therefore by downward traction, the anterior shoulder is brought to lie behind the symphysis pubis so that the inferior angle of the anterior scapula can be felt. When this is done the posterior shoulder must lie below the promontory of the sacrum and therefore below the pelvic brim. The pelvic girdle is then firmly gripped by both hands and the foetus turned through 180° so that the foetal back always remains upwards. The breech should be lifted upwards and moderate traction is used during the process of rotation. By this means the posterior shoulder is brought to the front and inevitably appears beneath the symphysis pubis. The arm may be delivered spontaneously; if not, it can easily be hooked out by digital pressure. The other shoulder which previously lay anteriorly and above the brim of the pelvis now lies in the hollow of the sacrum. The foetus, therefore, is rotated through 180° in the opposite direction, the

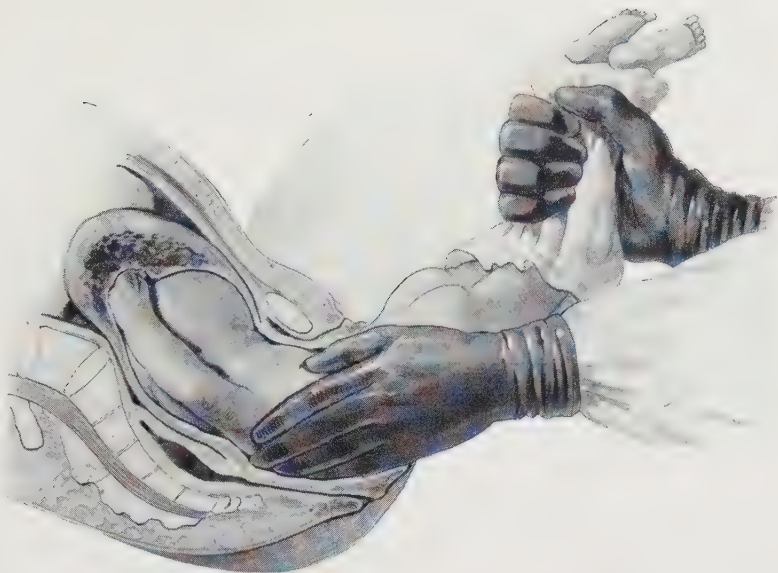


FIG. 128.—EXTENDED ARMS: BRINGING DOWN THE POSTERIOR ARM.

The child's body is swung up towards the mother's abdomen. Two fingers of the left hand are being passed up to the bend of the elbow to flex the arm and bring it down with a wide sweep across the child's face.

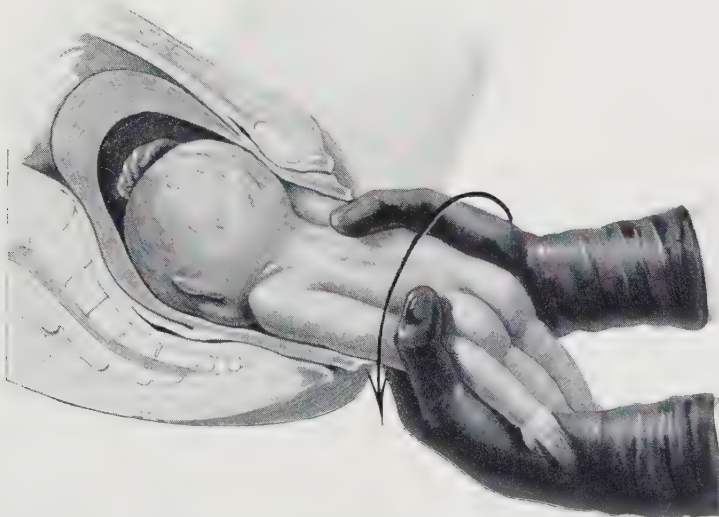


FIG. 129.—EXTENDED ARMS: ROTATION OF THE BODY TO DISENGAGE THE ANTERIOR ARM.

The anterior arm is tightly wedged behind the symphysis. The child's body is rotated in the direction which will bring the arm across the face.

foetal back again being kept upwards. The remaining arm is thereby easily delivered. The classical method necessitates a general anæsthetic. A firm grasp is taken of the legs, and fairly strong traction exerted in the axis of the pelvis. The trunk is then lifted upwards to swing the posterior shoulder into the hollow of the sacrum, and a hand is inserted into the vagina, along the lateral and posterior wall of the chest until the elbow is reached (Fig. 128). Two fingers are placed along the humerus and pressure made on the antecubital fossa to flex the forearm.



FIG. 130.—DORSAL DISPLACEMENT OF THE ARM.

To undo this displacement the body is rotated so as to make the face look towards the displaced arm. The fingers grasp the child by the thorax, not the abdomen.

which can then be swept down in front of the face. Once the posterior arm is delivered, the trunk will have to be rotated so that the anterior shoulder comes to lie in the hollow of the sacrum, and it should be rotated in the direction which will bring the arm across the face (Fig. 129). If dorsal displacement of the arm behind the neck should occur, the trunk should again be rotated in such a manner that the face moves towards the extended arm (Fig. 130). For such rotation the baby's thorax must be firmly grasped by both hands, and care taken not to injure the liver or other viscera. Manipulations of the arms must be gentle to avoid fracture or nerve injury.

Difficulty with the Aftercoming Head

Following the birth of the shoulders the flexed head enters the pelvis in the transverse diameter of the brim. As descent occurs forward rotation of the back will be noticed and this occurs as the head undergoes internal rotation so that the occiput comes to lie behind the symphysis pubis. The neck rests under the pubic arch and normally the head is born by a movement of flexion. Arrest in the descent of the aftercoming head is usually due to deflexion caused by pulling on the breech; occasionally it is due to disproportion or hydrocephalus. At the pelvic brim deflexion should be treated by letting the weight of the foetus exert traction in the axis of the pelvic inlet, and suprapubic pressure should be applied to the head to increase flexion. Any failure of descent or difficulty in the delivery of the head indicates the necessity for immediate assistance. The body of the baby having been born and the placental circulation having been greatly diminished by the retraction of the uterus, efforts at respiration will almost certainly be made. If the birth of the baby is not completed within the next few minutes death from asphyxia is likely to take place. The long curved obstetric forceps should be readily available for immediate use at every breech delivery and the instrument should be used immediately to complete delivery whenever the descent of the head is arrested in the cavity of the pelvis. The usual method of application of the forceps is as follows. The body of the baby is lifted well upwards by an assistant and the blades are applied beneath the baby. The fingers of the right hand steer the left blade of the instrument into the left side of the pelvis and the application of the right blade is made in a similar manner. Satisfactory locking of the two blades together with approximation of the handles denote a correct application to the foetal head (Fig. 131). Only moderate traction should be necessary to complete delivery as resistance from the pelvic floor has been removed by the episiotomy which has been performed and the birth canal has already been dilated by the birth of the body of the child.

Very occasionally the foetal head cannot be made to enter the pelvic brim at all. Apart from the fact that the head may be lying transversely, flexion will almost certainly be poor, or absent, and the application of the forceps to the head at this level is always dangerous, unsatisfactory and exceedingly difficult. In the rare event of arrest occurring at this level assistance should be rendered in the following manner. One hand is passed into the vagina posterior to the baby's thorax and a finger finds and presses on the jaw to produce flexion; the other hand is passed along the back until index and middle fingers curve over the shoulders to exert traction (Fig. 132). The head will be lying more or less in the

transverse diameter of the brim, and it should be drawn through in this diameter by traction on the shoulders. As the head comes down into the pelvic cavity it must be kept flexed and then rotated until the neck lies under the pubic arch. Delivery can then be completed by lifting the baby's trunk towards the mother's abdomen.



FIG. 131—FORCEPS DELIVERY OF THE AFTER-COMING HEAD.

Illustration shows the position of the forceps and of the body of the baby during delivery of the after-coming head of breech presentation.

When delivering the after-coming head by traction on the baby's trunk, the possibility of causing injury to the baby must be borne in mind. Too strong traction on the shoulders may cause injury to the cervical spine, and this injury is particularly likely to occur if the trunk is lifted upwards before the head has reached the pelvic floor. Forcible traction and rotation of the trunk may cause tearing and hæmatoma formation in the sterno-mastoid muscle, or the roots of the brachial plexus may be injured. This may cause complete paralysis of the arm, or an Erb-Duchenne palsy if only the fifth and sixth cervical roots

are torn. Once the foetal head has been directed through the brim and into the cavity of the pelvis, its delivery should be completed with the obstetric forceps, especially if further descent presents apparent difficulty.

Difficulty at the outlet may occur if the outlet is contracted, or if the occiput has rotated posteriorly. Delivery again should be completed by the application of the obstetric forceps to the after-coming



FIG. 132.—DELAY IN THE PELVIC CAVITY. JAW FLEXION AND SHOULDER TRACTION.

The child's body rides on the left fore-arm. A finger passed into the mouth keeps the head flexed, while traction is applied to the shoulders by the first and middle fingers over the clavicles.

head. When the occiput lies posteriorly and cannot be rotated, the forceps must be applied in front of the baby's body which is supported by an assistant.

Finally the presence of a breech presentation may in certain circumstances constitute a clear indication for delivery of the baby by Cæsarean section. This treatment would especially be indicated in the case of a woman whose age is 35 or over and who is pregnant for the first time. It may be that she has waited many years for conception to occur.

OBLIQUE LIE AND SHOULDER PRESENTATIONS

When the foetus lies with its long axis in the transverse axis of the uterus the lie is said to be transverse ; when in an oblique axis of the

uterus, the lie is said to be oblique. During the later weeks of pregnancy the latter is very much more common than the former. In cases of transverse and oblique lie the point of the shoulder is usually the presenting part, and after rupture of the membranes an arm may prolapse. The frequency of shoulder presentations is about one in 250 labours.

CAUSE

The commonest cause of an oblique lie is multiparity, associated with a lax abdominal wall. It is not infrequently found on antenatal



FIG. 133.—SHOULDER PRESENTATION: DORSO-ANTERIOR POSITION.

The head is in the left iliac fossa, the back lies anteriorly and obliquely, and the breech is on the right above the right iliac fossa.

examination some time before labour; prematurity is therefore a cause. An oblique lie may also be found with hydramnios or in twin pregnancy, and causes which interfere with engagement of the head, such as contracted pelvis, pelvic tumour or placenta prævia must always be considered.

POSITIONS

The foetus may lie with the head in either iliac fossa, the back sloping obliquely across the pelvic brim, whilst the breech usually

occupies a somewhat higher position than the head, on the opposite side of the abdomen. Only two positions are designated, dorso-anterior and dorso-posterior, the former being the more common.

DIAGNOSIS

On abdominal inspection the uterus appears somewhat asymmetrical, being broader than usual, and the fundus not so high as would be expected for the duration of pregnancy. On palpation the hard round head will be felt in one iliac fossa, and the softer more irregular breech on the opposite side and at a somewhat higher level. The absence of any definite presenting part at the pelvic brim is an important diagnostic point. Across the middle of the abdomen the back will be felt in dorso-anterior positions, and small parts in dorso-posterior positions. The heart sounds are usually best heard just below the umbilicus (Fig. 133).

On vaginal examination during pregnancy or at the beginning of labour, the presenting part will be too high to be felt.

During labour the membranes bulge in an elongated manner and generally rupture early. Before rupture an arm may be felt in the bag of membranes, and after rupture prolapse of an arm often occurs, or a loop of cord may prolapse. Diagnosis of a shoulder presentation depends

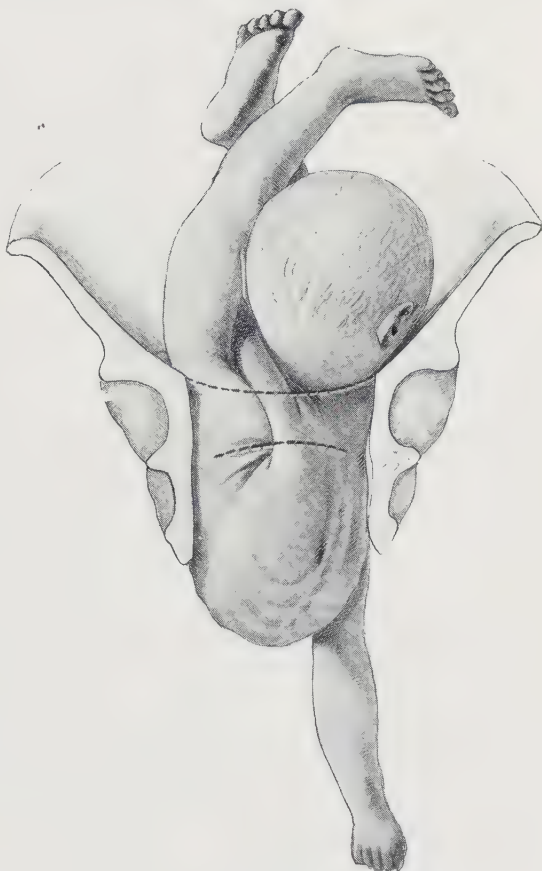


FIG. 134.—SPONTANEOUS EVOLUTION.

The body is squeezed past the head by extreme flexion; the ribs distend the perineum, whilst the breech occupies the sacral hollow.

on the recognition of the acromion process, scapula and ribs ; if the shoulder has become oedematous it may be mistaken for a breech. A prolapsed arm must be distinguished from a leg ; the elbow is sharper than the knee, and the absence of a heel and abduction of the thumb will distinguish hand from a foot. A diagnosis can be made of which hand has prolapsed by shaking hands with the prolapsed hand.

COURSE OF LABOUR

As the foetus, lying obliquely, cannot be born naturally, unless it is very premature, there is no true mechanism of delivery, and an untreated case will end in obstructed labour and foetal death.

Spontaneous Rectification to a vertex or more rarely a breech may sometimes occur early in labour, but cannot do so after prolapse of an arm.

Spontaneous Delivery in a neglected shoulder presentation may occasionally occur with a very premature foetus which is usually stillborn. With forcible and prolonged uterine action, the shoulder may appear at the vulva, and be followed by the trunk, breech and finally the head. (Spontaneous evolution, Fig. 134.) Or the foetus may be delivered doubled up, with the chest and pelvis pressed together, followed by the head and limbs. (Spontaneous expulsion, Fig 135.)

PROGNOSIS

A shoulder presentation in a primigravida is particularly serious because of the causes which interfere with engagement of the head, such as contracted pelvis, pelvic tumours or placenta prævia. These conditions are likely to cause difficulty or obstruction in labour even though the malpresentation can be rectified. Furthermore the necessary manipulations during labour are more difficult in a primigravida.

In a multipara a shoulder presentation is commonly due to a lax abdominal wall, and the prognosis depends on early recognition of the malpresentation. The prognosis is good if a vertex presentation can be obtained when labour begins. If a shoulder is presenting at the onset of labour, the membranes are likely to rupture early, with prolapse of an arm and possibly a loop of cord ; internal manipulations and delivery as a breech will then increase the risk to both mother and foetus.

Neglected shoulder presentations are extremely serious, since all the risks of obstructed labour are present, including rupture of the



FIG. 135.—SPONTANEOUS EXPULSION.

Delivery of a premature or macerated foetus by doubling and compression of the body



FIG. 136.—RECTIFICATION OF AN OBLIQUE LIE BY EXTERNAL MANIPULATION.

The body of the child is raised and the breech pushed towards the fundus by the left hand while the right hand presses the head down into the pelvic brim.

over-distended lower uterine segment and possible infection of the uterus and foetus ; in the case of the foetus, death is usual from interference with the circulation in the placental-site.

TREATMENT

Before Labour.—During pregnancy an oblique lie should be corrected by external cephalic version to a vertex presentation (Fig. 136). A careful investigation must be made for a cause, such as contracted pelvis, pelvic tumour or placenta prævia, which may be interfering with the engagement of the head, and may perhaps necessitate Cæsarean section. The malpresentation is liable to recur, so an abdominal binder should be applied, and frequent abdominal examinations are advisable. After the 38th week it may be permissible to rupture the membranes after version, but it is better to ensure that the patient is examined at the onset of natural labour, so that the presentation can be finally rectified if necessary, and the vertex presentation subsequently maintained.

Early in Labour.—With efficient antenatal supervision, an oblique lie should not be found at the time of the onset of labour, but if present it may still be corrected by external cephalic version if the membranes are intact. Once the oblique lie has been rectified the uterine contractions will assist in maintaining the longitudinal lie, especially if the membranes are then ruptured.

When the Membranes have Ruptured.—If the patient has not long been in labour, it is usually possible and advisable to perform podalic version by some internal manipulation ; either by bipolar version if the cervix admits two fingers, or internal version if the whole hand can be inserted. For this procedure the patient must be anæsthetized, and it is essential that the uterus relaxes fully between the contractions. If an arm has prolapsed into the vagina, a sterile tape may be placed round the baby's wrist to prevent subsequent extension of the arm which should be covered with dettol cream and replaced inside the uterus. Aided by abdominal manipulations the foetus is then turned and the nearest leg brought down through the cervix.

Late in Labour, when the Shoulder has become Impacted (Fig. 137). In neglected cases when the uterus is verging on tonic retraction, *i.e.* when every attempted manipulation within the uterus is resisted, there is the gravest danger in attempting any form of version, owing to the very great risk of rupturing the thinned lower uterine segment. If the foetus is alive, a lower segment Cæsarean section may be considered if conditions are suitable, but as a rule the

fœtus will have perished from the interference with the circulation of the placental site, due to the tonic retraction of the uterus, and therefore only the mother's safety requires consideration. The usual method of delivery in such a case is by decapitation. This requires full



FIG. 137.—SHOULDER PRESENTATION WITH PROLAPSE OF ARM.

The shoulder and arm, forming the apex of the wedge, are driven into the brim; the head and neck on the one side and the trunk on the other form the sides of the wedge.

anæsthesia, and is a somewhat difficult procedure, associated with high maternal mortality and morbidity, but the risk to the mother is probably less than that of Cæsarean section.

COMPLEX PRESENTATIONS

Prolapse of the limbs occurring with a vertex presentation is known as a complex presentation. Commonly it is the hand which comes down, rarely the foot, and very occasionally hand and foot.

Prolapse of an arm occurs under much the same conditions as prolapse of the umbilical cord; with a small premature head in a large pelvis, or under conditions in which the head does not fit the brim properly, such as a flat pelvis (Fig. 138).

TREATMENT

If the head is not low in the cavity, it will often be found that the arm goes back as the head descends, and active treatment is not required. If the head is small and the pelvis capacious, there may be



FIG. 138.—COMPLEX PRESENTATION.
Prolapse of arm with vertex presentation.

room for the head to pass even if the arm remains down. If the progress of the head is arrested the arm should be replaced under anæsthesia, and the head then pressed down into the brim. Delivery may be completed by forceps if the cervix is fully dilated. The possibility of disproportion should be remembered when the head is found fixed in the brim.

When a foot presents with the head, it may be pushed up under anæsthesia, or it may be better to pull on the foot and push up the head, turning the fœtus into a footling presentation. When the head is low in the pelvis, the forceps should be applied to the head and the foot pushed up out of the way. When the hands and feet come down together, the legs should be brought down, and the fœtus delivered as a breech.

CHAPTER XXXI

PRESENTATION, PROLAPSE AND EXPRESSION OF THE UMBILICAL CORD

DESCENT of the umbilical cord below the presenting part occurs about once in 350 births, and constitutes a grave risk to the fœtus because of the danger of impairment of the circulation in the umbilical cord vessels.

Three clinical types of descent are described :—

1. *Presentation*, when the umbilical cord lies below the presenting part in the intact bag of membranes (Fig. 139). This is in fact rarely discovered, and of course after rupture of the membranes it becomes prolapse of the cord.

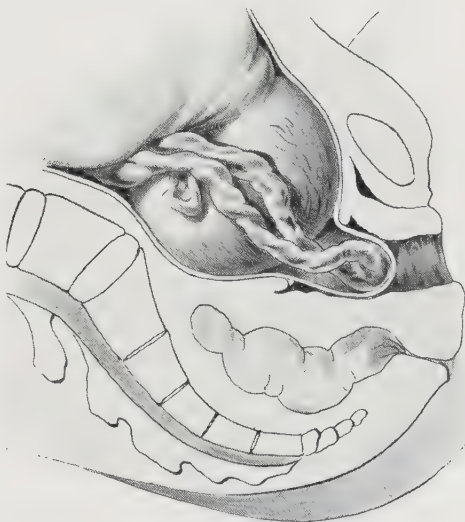


FIG. 139.—PRESENTATION OF THE CORD.

2. *Prolapse*, when the cord descends below the presenting part when the membranes rupture.

3. *Expression*, when the cord is squeezed past the presenting part a considerable time after the membranes have ruptured.

CAUSES

Descent of the umbilical cord is more likely to occur when the presenting part does not completely occupy the lower segment of the

uterus; in normal labour the well-flexed vertex engages before the onset of labour or soon after, and tends to prevent prolapse of the cord.

Prolapse of the cord is therefore particularly likely to occur as a complication of malpresentations such as breech or shoulder presentations, and occasionally with a brow, face or even an occipito-posterior position of the vertex. Nevertheless it occurs with a normal vertex presentation in over half the cases, and is more likely to occur when the head is free above the pelvic brim. Excess of liquor amnii, by permitting greater mobility of the foetus, tends to produce malpresentation, and when the membranes rupture a sudden gush of liquor may carry a loop of cord down into the vagina.

Prolapse of the cord is more likely to occur with a premature or small foetus, and is often a complication of labour with twins. Contracted pelvis is an important cause of prolapse of the cord, and in the rachitic pelvis the space on either side of the engaging head favours its occurrence. Contracted pelvis due to rickets has become a rarity, and is not often found nowadays as a cause of prolapsed cord, but it must always be looked for, and the pelvis carefully examined in every case.

In some cases of descent of the umbilical cord the cord is unduly long, and there is little doubt that excessive length is an important cause. Low implantation of the placenta, placenta prævia, will also facilitate descent, but this is not often found.

DIAGNOSIS

Presentation of the umbilical cord is seldom discovered. This may be because it is less common than prolapse of the cord, and also because patients are not invariably examined vaginally at the onset of labour, and even if so examined, the condition may easily be missed, particularly if the presenting part is high. Nevertheless a presenting cord can be felt through the intact bag of membranes and pulsation of the cord vessels should be recognized. Pulsation may also be felt in vasa prævia, in which there is a velamentous insertion of the cord, and the velamentous portion crosses the membranes covering the internal os. Slowing of the foetal heart has been recorded when the head is pushed into the pelvic brim in presentation of the cord, but slowing may also be observed in placenta prævia, or in vasa prævia, or in the absence of any abnormality, simply as a result of compression of the foetal head.

In prolapse of the cord the diagnosis presents no difficulty as a loop of cord is felt in the vagina, and may even present at the vulva. It should be a rule that every patient is examined vaginally as soon as possible after rupture of the membranes, whether she is having contractions or not, in order to exclude or diagnose prolapse of the cord.

The loop of cord should be palpated to see if pulsations are present, but it must be remembered that even if the cord is compressed so that pulsations are absent, the foetus may yet be alive, and foetal heart sounds audible on auscultation of the abdomen.

Whenever presentation or prolapse of the cord is diagnosed, the degree of dilatation of the cervix should be noted, and the cause sought. The diagnosis of twins, malpresentation or contracted pelvis should be considered.

PROGNOSIS

Presentation or prolapse of the cord does not in itself increase the risk to the mother, except for the slightly increased risk associated with complications such as twins, malpresentation or contracted pelvis, if present, but descent of the cord often calls for speedy delivery, either by forceps, breech extraction or by Cæsarean section, in order to save the child, and these procedures inevitably increase the maternal risk to some extent.

The prognosis for the foetus in presentation or prolapse of the cord is grave; stillbirth or neonatal death occurs in about 30 per cent of cases. It is said that the prognosis is worse when the head presents as it is more likely to compress the cord, but it can also be compressed by a breech presentation; in a shoulder presentation there is more chance that the cord will escape compression.

The prognosis for the foetus has been improved in recent years by the more frequent use of Cæsarean section in cases of prolapse of the cord when the cervix is not fully dilated.

TREATMENT

Treatment depends on whether the foetus is alive or dead, and on the dilatation of the cervix, and will be considered under these headings :

1. With an incompletely dilated cervix, and a live foetus.
2. With an incompletely dilated cervix, and a dead foetus.
3. With a fully dilated cervix.

1. With an incompletely dilated cervix and a live foetus.

(a) *Cæsarean Section*.—In a case of presentation or prolapse of the cord, if the cervix is not fully dilated, the best chance of getting a live child is by Cæsarean section. This should be undertaken immediately. In every maternity unit the theatre should be ready for emergency Cæsarean section at short notice. If the membranes have not already ruptured, nothing should be done which might cause them to rupture,

as the intact bag of membranes makes it unlikely that compression of the cord will occur.

If pulsation is not felt in a prolapsed cord it must not be assumed that the foetus is dead. If the cord has only been compressed for 5 or 10 minutes the foetal heart may still be heard on auscultation, and immediate steps must be taken to relieve the compression of the cord. This may be achieved by the knee-chest position, which tends to keep the presenting part out of the pelvis, thus relieving compression (Fig. 140).



FIG. 140.—THE KNEE-CHEST POSITION IN THE TREATMENT OF PRESENTATION OF THE CORD.

In this position the cord tends to sink towards the fundus and the presenting part to leave the brim; thus the risk of pressure on the cord is diminished.

This position causes the patient considerable discomfort, and if used should not be continued for more than ten minutes. A steep Trendelenberg position on the operating table has a similar effect. A more practical method is to push the presenting part up above the brim by digital pressure from below, and to maintain it there by upward pressure with a hand above the symphysis pubis; this is helped by blocking the foot of the bed, and auscultation of the foetal heart will confirm that compression has been relieved. One of these methods should be used whilst preparations for Cæsarean section are being made, even if the cord is found to be pulsating.

(b) *Replacement of the Cord.*—The only alternative to Cæsarean section in cases in which the cervix is not fully dilated is to replace the prolapsed cord above the presenting part. This may be attempted by wrapping the loop of cord loosely in sterile gauze, and then pushing it up above the presenting part. With any method of replacement the prognosis for the foetus is poor. The cord often prolapses again, or

being incompletely replaced remains compressed. Manipulation of the cord and the effect of cold air causes spasm of the cord vessels which impairs the circulation even if the cord is not actually compressed. If replacement is achieved, an attempt should be made to prevent recurrence of the prolapse by pushing the head into the pelvis and maintaining it there with a tight abdominal binder, or even by applying Willet's scalp forceps to the head and attaching thereto a 1 pound weight traction. With a breech or shoulder presentation a leg should be brought down, and gentle traction maintained. As soon as the cervix is fully dilated, delivery should be expedited by the forceps or breech extraction according to the presentation.

2. With an incompletely dilated cervix and a dead fœtus.—

If the cervix is not fully dilated and the foetal heart cannot be heard it must be presumed that the fœtus is dead. Cæsarean section is not justified and there is no indication for interference so far as the prolapsed cord is concerned. Sedative drugs should be given and the labour allowed to proceed, unless a shoulder presentation or a contracted pelvis necessitates intervention.

3. With a fully dilated cervix. If the cervix is fully dilated when prolapse of the cord is first discovered, and this is not at all uncommon, then immediate vaginal delivery is indicated, without attempting to replace the prolapsed cord. Delivery should be effected by forceps if the head presents, or by breech extraction if a breech. If a prolapsed cord is found with a shoulder presentation, internal version and breech extraction are required, but the danger of rupturing the lower segment must be remembered, and Cæsarean section is preferable if there is any question of tonic retraction of the uterus.

With a fully dilated cervix immediate delivery is advisable, even if pulsation cannot be felt in the cord ; it may yet be possible to resuscitate the child. Facilities for the treatment of asphyxia, including an inclined plane, intragastric tube and special oxygen flowmeter, should be available in every labour ward, and should be in readiness whatever method of treatment has been carried out for a prolapsed cord.

CHAPTER XXXII

ABNORMALITIES OF THE PELVIS

THE radiological studies of Caldwell and Moloy have shown that the typical female or gynæcoid pelvis is present in less than 50 per cent. of women. They described four types of pelvis, which should not be regarded as abnormal unless there is considerable reduction in the size of the diameters in one or more planes of the pelvis.

1. *The Gynæcoid Pelvis* conforms to the accepted female type in that the brim is rounded, with the widest transverse diameter slightly

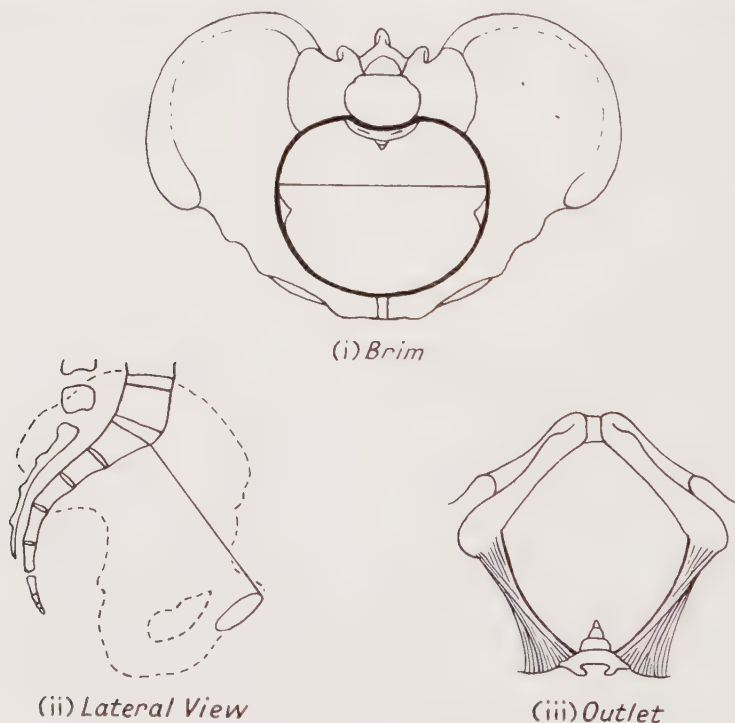


FIG. 141.—THE GYNÆCOID PELVIS.

behind its centre (Fig. 141). The average dimensions of the brim are antero-posterior diameter 11.2 cm. ($4\frac{1}{2}$ inches) and transverse diameter 13.2 cm. ($5\frac{1}{4}$ inches). The sub-pubic arch is rounded, with

an angle of about 85° . Caldwell and Moloy found this type of pelvis in 41.4 per cent. of women.

2. *The Android Pelvis* was found in 32.5 per cent of women, and it has many characteristics of the male pelvis. The brim is heart-shaped so that the widest transverse diameter is much nearer the sacrum than it is in the gynæcoid pelvis (Fig. 142). The average dimensions of the

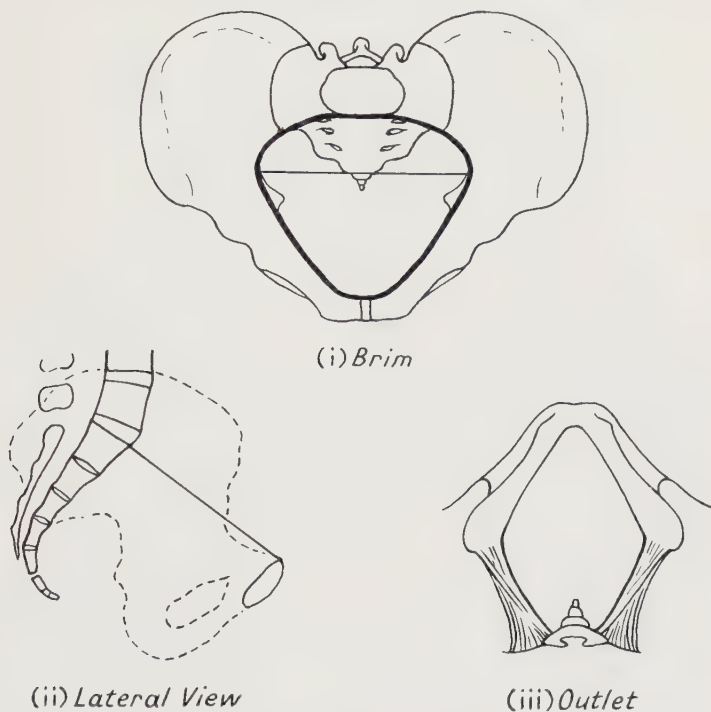


FIG. 142.—THE ANDROID PELVIS.

brim are antero-posterior diameter 10.2 cm. (4 inches) and transverse diameter 12.9 cm. (5 inches). The side walls tend to converge, and the sub-pubic arch is usually narrow, with an angle of 60° or 70° . Both the antero-posterior and transverse diameters of the outlet average 10.2 cm. (4 inches). This pelvis corresponds to the funnel-shaped pelvis of former writers.

3. *The Anthropoid Pelvis* was found in 23.5 per cent. of women. The antero-posterior diameters of brim and outlet exceed the transverse diameters (Fig. 143). The average dimensions of the brim are antero-posterior diameter 12.8 cm. (just over 5 inches), and transverse diameter 12 cm. ($4\frac{3}{4}$ inches). The pelvis tends to be deep and the

sacrum frequently has 6 segments instead of 5. Very often the sacrum and the axis of the pelvic cavity are straighter or less curved than in the gynæcoid pelvis. The sacro-sciatic notch is wide and the sub-pubic arch tends to be narrow, about 70° , but the antero-posterior diameter of the outlet averages 12.6 cm. (5 inches).

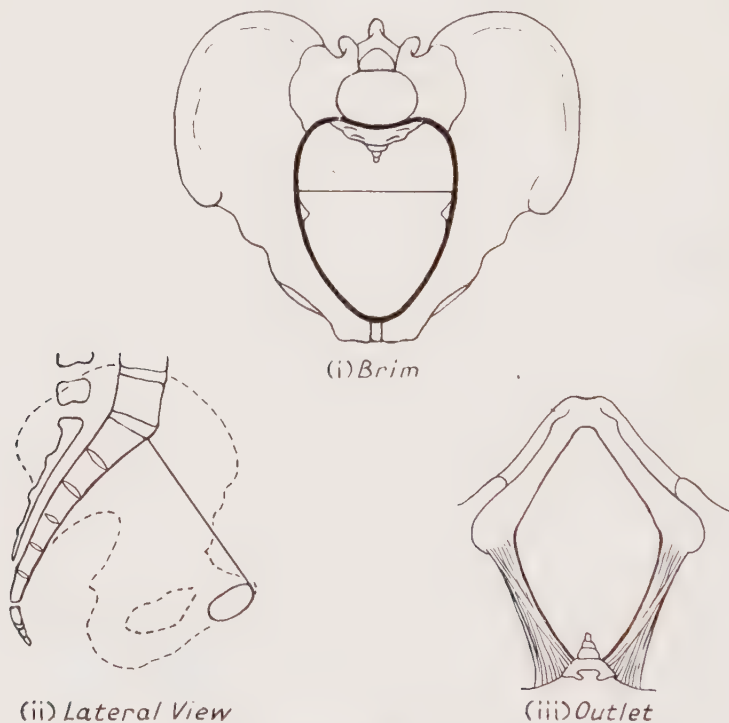


FIG. 143.—THE ANTHROPOID PELVIS.

4. *The Platypelloid Pelvis* was found in only 2.6 per cent. of women, and corresponds to the simple flat pelvis of former writers. The brim is elliptical with a wide transverse diameter (Fig. 144). The average dimensions of the brim are antero-posterior diameter 10.6 cm. ($4\frac{1}{2}$ inches), and transverse diameter 14.3 cm. ($5\frac{3}{4}$ inches). The sub-pubic arch is wide and rounded as a rule, measuring 90° to 100° .

It must be emphasized that these variations in shape have little effect on the normal mechanism of labour unless there is considerable reduction in any of the pelvic measurements. The rounded gynæcoid pelvis is perhaps the most favourable shape, and the android pelvis is the least favourable to a normal mechanism because of the tendency to contraction of the outlet. The anthropoid pelvis favours engagement

of the head in the antero-posterior diameter of the brim, and if it engages as an occipito-posterior it may fail to undergo internal rotation, and be delivered face to pubis. The platypelloid pelvis favours engagement of the head in the transverse diameter of the brim.

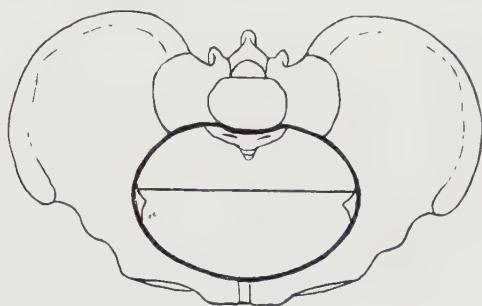
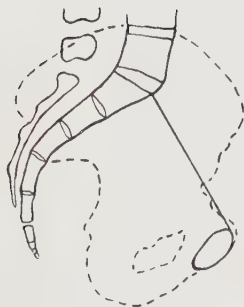
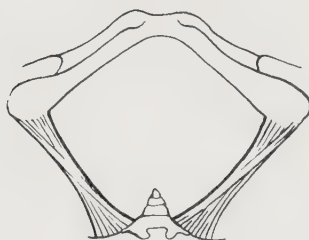
(i) *Brim*(ii) *Lateral View*(iii) *Outlet*

FIG. 144.—THE PLATYPELLOID PELVIS.

ABNORMALITIES OF THE PELVIS

Abnormalities of the pelvis may be classified in three groups :

1. *Developmental*

Small gynæcoid, generally contracted, or small round pelvis.

Small android, male or funnel-shaped pelvis.

Small anthropoid pelvis.

Small platypelloid or simple flat pelvis.

The oblique pelvis of Nægele.

The transversely contracted pelvis of Robert.

2. *Disease or Injury of the Pelvic Bones.*

The rachitic flat pelvis.

The osteomalacic pelvis.

Fractured pelvis.

New growths of the pelvic bones.

3. *Abnormalities of the Spine, Hip Joints and Lower Limbs.*

The kyphotic pelvis.

Spondylolisthesis.

The high assimilation pelvis.

The low assimilation pelvis.

Hip disease, including congenital dislocation of the hip.

Defect of one leg, causing tilting of the pelvis.

1. Developmental Abnormalities.—This group includes the small gynæcoid or generally contracted pelvis, the small android or funnel-shaped pelvis, the small anthropoid pelvis and the small platypelloid or simple flat pelvis. The presence of a sixth segment in the sacrum which may be found with an anthropoid pelvis has given rise to the term high assimilation pelvis, but these developmental anomalies are not in themselves of any great significance. Very rarely malformation of the pelvis may result from defective development of one side of the sacrum, which is fused with the ilium. This is known as the oblique pelvis of Nægele, and if bilateral is known as the transversely contracted pelvis of Robert.

2. Disease or Injury of the Pelvic Bones. Distortion of the pelvis may be caused by mal-united fractures or by new growths arising from pelvic bones. The most important abnormality in this group is rickets, which causes softening of the pelvic bones and rachitic deformity in early life. Fortunately the disease is becoming uncommon in this country. A similar disease, osteomalacia, which may occur in adults, can cause very severe distortion of the pelvis; it is almost unknown in this country, but may still occur in Central Europe and Asia.

3. Abnormalities of the Spine, Hip Joints and Lower Limbs.

The shape and inclination of the pelvis may be markedly affected by kyphosis of the spine or by spondylolisthesis. Disease of the hip joints, particularly congenital dislocation and abnormalities of the lower limbs which affect the distribution of the body-weight, and cause tilting of the pelvis, may give rise to an oblique distortion of the pelvis. As scoliosis is usually present under these conditions, it is often referred to as the scoliotic pelvis, but pelvic obliquity is not caused by the scoliosis, and is only likely to occur if the condition was present before the completion of bone growth, about 17 or 18 years.

The Generally Contracted or Small Round Pelvis

This corresponds to the small gynæcoid pelvis, and is usually found in small women, but may also occur in women of normal stature. The diagnosis will be made by the small external pelvic measurements, and by a proportionate reduction in all pelvic diameters (Fig. 145).

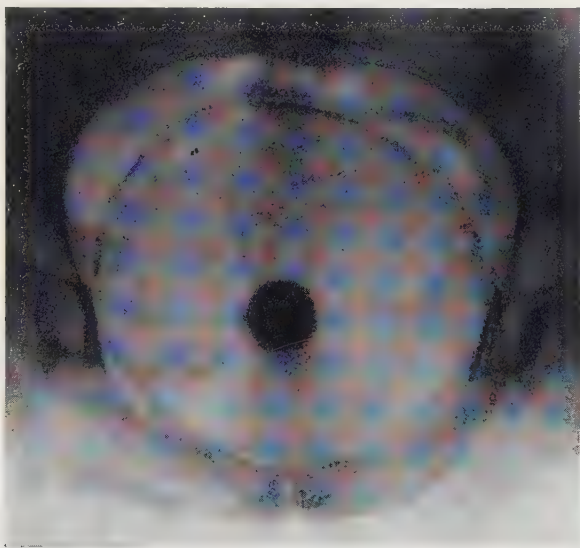


FIG. 145.—THE GENERALLY CONTRACTED OR SMALL ROUND PELVIS;
X-RAY OF INLET.

Mechanism of Labour.—In many cases the mechanism of labour is quite unaffected because the size of the foetal head at term is also small, and a birth-weight of about 6 pounds is to be expected. Disproportion may, however, occur, and the head may not engage until the first stage of labour. Extreme flexion of the head and excessive moulding may occur.

First Stage.—The brim may be too small to admit the head, but as the brim is rounded the head is not forced out to one side, as it may be with a flat pelvis. As the head fits into the brim tightly it cuts off the hind-waters from the fore-waters, and therefore premature rupture of the membranes or prolapse of the cord is unlikely to occur. With strong contractions the lower segment may be compressed against the brim, giving rise to œdema of the cervix, which fails to dilate if labour becomes obstructed. Malpresentations are uncommon, but the head has to undergo marked flexion, and there is usually a large caput succedaneum and extreme moulding (Fig. 146).

Second Stage. Although the outlet is small delivery of the head may not be unduly difficult as it has become well moulded, during its passage through the brim. There is often some delay in the second stage, and forceps delivery may be necessary because of maternal or foetal distress. Difficulty may also be experienced with the delivery of the shoulders.

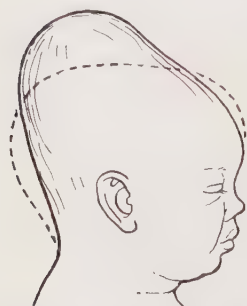


FIG. 146.—MOULDING AND CAPUT FORMATION RESULTING FROM SMALL ROUND PELVIS.

The after-coming head in breech delivery should also come through the pelvis with good flexion, but there is more likely to be difficulty with extended arms than with the after-coming head in this type of pelvis; the limited space available for internal manipulations makes breech delivery hazardous in a generally contracted pelvis.

The Small Android or Funnel-shaped Pelvis

It has already been noted that this type of pelvis is least favourable to the normal mechanism of labour, because of a tendency to contraction at the pelvic outlet. If all the pelvic measurements are small, or if there is marked convergence of the side walls of the pelvis with perhaps an inwardly projecting sacro-coccygeal shelf, there is likely to be a prolonged second stage, and there may be considerable difficulty in delivery. Severe degrees of contracted outlet are fortunately rare. With less severe degrees of contraction the difficulty can usually be overcome because of the fact that the antero-posterior diameter of the outlet is capable of being stretched. As a rule the sacro-coccygeal joint allows some backward displacement of the coccyx, and the sacrum, which is joined to the ischium by the sacro-sciatic ligaments, can undergo a limited degree of backward rotation. Nevertheless, the results of forcible forceps delivery to overcome outlet disproportion can be disastrous, and careful ante-natal examination of the outlet should never be neglected (Figs. 147 and 148).

Mechanism of Labour

First Stage.—Although engagement of the head may be delayed until the first stage of labour because of the heart-shaped pelvic brim, actual obstruction at the brim rarely occurs with an android pelvis. Malpresentations, particularly posterior positions of the occiput, are, however, likely to occur because the widest diameter lies in the posterior segment of the brim.

Second Stage.—Strong expulsive efforts may complete the normal mechanism of labour and result in spontaneous delivery, but the head

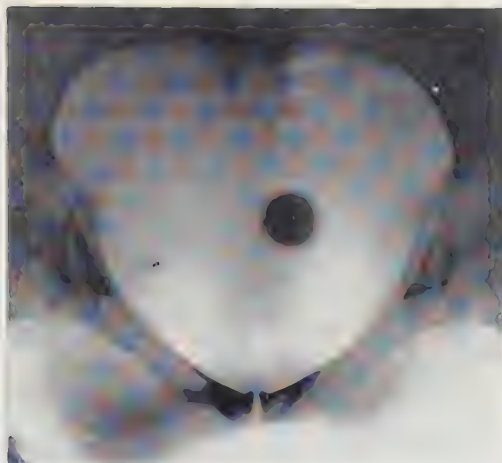


FIG. 147.—ANDROID PELVIS; X-RAY OF INLET, SHOWING HEART-SHAPED BRIM AND PROMINENT ISCHIAL SPINES.



FIG. 148.—ANDROID PELVIS; VIEW OF SUBPUBIC ARCH.

will have undergone considerable moulding and compression, and the perineum may be extensively torn, because the narrow sub-pubic arch forces the head to emerge more posteriorly than usual.

More often the second stage is prolonged, and forceps delivery is required. As a rule the head is held up in the pelvic cavity in the region of the ischial spines; it may be badly flexed, and usually lies transversely in the position known as deep transverse arrest. Occasionally the head is found impacted in the pelvis with the occiput posterior. Flexion and manual rotation of the head must precede the application of the obstetric forceps, and even then undue force may have to be used to effect delivery. An episiotomy should be performed to avoid a third degree perineal tear, but extensive laceration of the vaginal walls may occur laterally.

Fœtal distress may arise from a prolonged second stage, and intra-cranial hæmorrhage may result from excessive compression of the fœtal head during delivery. Delivery of the after-coming head in a breech presentation through a contracted outlet is particularly unfavourable.

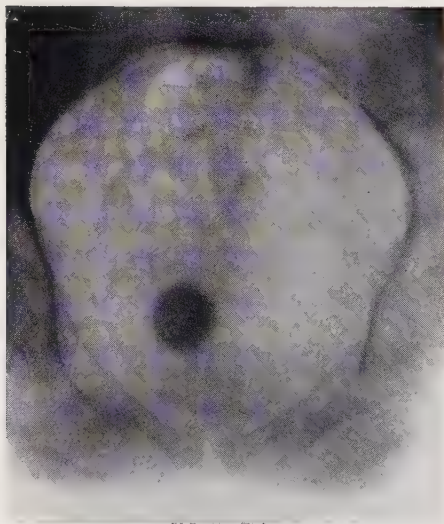


FIG. 149a.—ANTHROPOID PELVIS; X-RAY OF INLET, SHOWING LONG ANTERO-POSTERIOR DIAMETER.



FIG. 149b.—ANTHROPOID PELVIS; LATERAL VIEW, SHOWING SIX SEGMENTS IN SACRUM.

The Small Anthropoid Pelvis

In this type of pelvis also the head may fail to engage before labour in a primigravida, and it will tend to engage in the antero-posterior diameter of the brim. Disproportion between the biparietal diameter and the transverse diameter of the brim is almost unknown, and

difficulty is only likely to occur at the pelvic outlet if the head has engaged with the occiput posterior. Internal rotation may fail to occur because the anthropoid pelvis has not a marked pelvic curve, and a persistent occipito-posterior position results. Manual rotation of the head may be difficult because of the narrow transverse diameter of the pelvis (Figs. 149a and b). In this case the head should be delivered in the occipito-posterior position.

The Small Platypelloid or Simple Flat Pelvis

This type of pelvis is not very common, and may be difficult to distinguish from a mild degree of rachitic deformity. Disproportion may occur at the pelvic brim if the antero-posterior diameter is unduly small, and the clinical effects and mechanism of labour are similar to those described in the next section on the rachitic flat pelvis (Fig. 150).

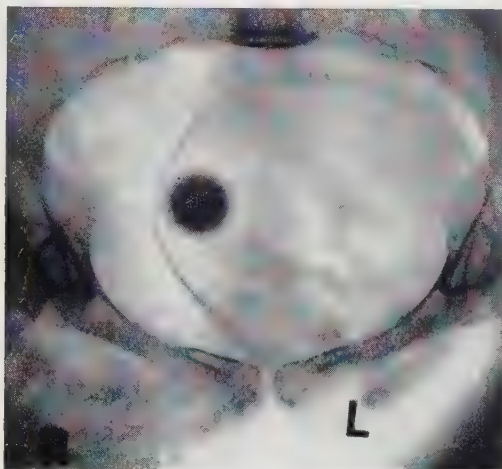


FIG. 150.—SIMPLE FLAT OR PLATYPELLOID PELVIS; VIEW OF INLET.

The Rachitic Flat Pelvis

Marked degrees of rachitic deformity of the pelvis have become very rare owing to the prevention and treatment of rickets in early life (Fig. 151). The characteristic rachitic deformities are produced in infancy as a result of softening of the bones due to vitamin D deficiency. The body-weight, transmitted through the spine and pelvis, tends to rotate the sacrum forwards, and to cause flattening of the brim, the transverse diameter becoming larger and the antero-posterior smaller than normal.

In marked cases the sacral promontory projects forwards, still further diminishing the true conjugate diameter, and the brim becomes kidney-shaped or reniform. In some cases the lower margin of the first sacral segment projects further forwards than the true promontory,



(i) *Brim*



(ii) *Lateral View*
(Showing forward displacement
of the sacral promontory)

FIG. 151.—RACHITIC PELVIS.

and the conjugate should be measured from it rather than from the true promontory. The side walls of the rachitic pelvis tend to diverge and the pelvic outlet is usually wide (Figs. 152 and 153).

Diagnosis.—A rachitic pelvis may be suspected if it is known that the patient spent her childhood in a part of the country where malnutrition and poor living conditions are still present, and if, in addition, signs of rickets are found. Shortness of stature, kyphosis of the spine, and bowing of the legs are characteristic, but the bossed head and rachitic rosary are not often seen now.



FIG. 152.—X-RAY SHOWING GROSS PELVIC DEFORMITY, PROBABLY DUE TO RICKETS.



FIG. 153.—RACHITIC PELVIS; LATERAL VIEW, SHOWING DISPROPORTION AT THE BRIM.

External pelvimetry may show that the interspinous diameter equals or is less than one inch smaller than the intercrystal diameter, and the external conjugate may be smaller than the average. These findings are due to the splaying outwards of the iliac crests and the forward rotation of the sacrum. On vaginal examination the sacral promontory may be easily felt and the diagonal conjugate may be considerably less than normal, but the transverse diameters of brim and outlet are usually increased.

In early pregnancy incarceration of the retroverted gravid uterus may occur because of the overhanging sacral promontory. In the later months the presenting part is found to be freely movable above the brim, and if it is a cephalic presentation the head cannot be made to engage. Malpresentations are likely to occur. Finally, the diagnosis of a rachitic pelvis may be made by X-ray studies, undertaken because of clinical evidence of disproportion at the brim.

Mechanism of Labour. The head does not enter the brim easily, and may even be displaced into one or other iliac fossa. Because the head does not accurately fit the distorted brim, elongation of the bag of membranes and premature rupture of the membranes are likely to occur, and sometimes a loop of cord prolapses alongside the head. There may be considerable delay in the first stage of labour because the head fails to pass through the brim. The cervix does not dilate easily because the head does not come down to stretch it, and it will become oedematous because the head compresses the lower uterine segment against the symphysis pubis and sacral promontory.

Difficulty at the pelvic brim in a rachitic pelvis may be overcome by strong uterine contractions, and this will be aided by moulding of the foetal head, but the following points should be noted in the mechanism :

1. The head engages in the transverse diameter of the brim rather than in an oblique diameter.

2. The head is displaced laterally so that the occiput and biparietal diameter (9.3 cm. or $3\frac{3}{4}$ inches) can descend to one side of the sacral promontory, the bitemporal diameter (8.1 cm. or $3\frac{1}{4}$ inches) passing through the true conjugate. If the biparietal diameter becomes fixed in the mid-line of the brim the head may very rarely become extended to produce a brow or face presentation, but this will not aid the mechanism.

3. The transverse diameter of the foetal head from a point just below one parietal eminence to a point just above the other is rather less than the biparietal diameter, and is called the *subparieto-superparietal diameter*. Most commonly the anterior parietal bone descends first, the head tilting towards the posterior shoulder. This is known as

anterior parietal presentation, Nægele's obliquity or posterior asynclitism (Fig. 154). When the anterior parietal eminence has descended past the symphysis, the posterior parietal eminence is forced past the sacral promontory by tilting of the head towards the anterior shoulder. Posterior parietal presentation or anterior asynclitism occurs infrequently, and is said to be less favourable than Nægele's obliquity.



FIG. 154.—ANTERIOR PARIETAL PRESENTATION OR NÆGELE'S OBLIQUITY.

Once the head has passed through the contracted brim of a rachitic pelvis the normal mechanism of flexion and internal rotation should follow. As a rule the outlet is wide, and delivery of the head may be quite easy.

With the after-coming head of a breech presentation the mechanism of labour is similar, but the tendency to extension of the head will be greatly increased by traction on the fœtus, so that the head will become fixed in the brim, and greatly diminish the chances of delivering a live child. Although internal podalic version has, in the past, been practised for a contracted brim, the prognosis is, in fact, far less favourable for a breech than for a vertex presentation.

Effects on Mother and Child.—Direct injury to the cervix, vaginal vault and bladder may be caused by the high forceps operation in a woman with a rachitic pelvis. If the head has been allowed to mould its way slowly through the brim there may also be considerable damage to the maternal tissues from pressure necrosis, and a vesico-vaginal fistula has been known to develop a week or ten days after delivery, from sloughing of the tissues.

Considerable moulding of the head is likely to occur (Fig. 155), and intracranial hæmorrhage may cause death of the fœtus during labour, or

neonatal death. An abrasion may sometimes be seen over one or other parietal bone where it has been forced past the sacral promontory, and occasionally a spoon-shaped depression may be found in one parietal bone, where it has been indented by the promontory.

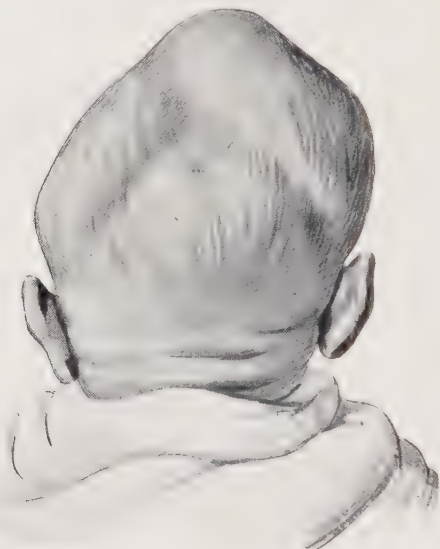


FIG. 155.—FETAL HEAD AFTER LONG LABOUR WITH A RACHITIC PELVIS.

The parietal bone which was posterior has become somewhat flattened and its upper edge has been pushed under the anterior parietal bone. A caput succedaneum has formed over the latter.

The Osteomalacic Pelvis

Osteomalacia is also a deficiency disease, accompanied by marked softening of the bones. The pelvic deformity may be extreme, both acetabula and the sacral promontory being pushed inwards to form a triradiate pelvis, through which delivery of the foetus is quite impossible. Osteomalacia may occur in adults as well as in children, but fortunately it is becoming of historical interest only (Fig. 156 and Fig. 157).

The Kyphotic Pelvis

Pelvic deformity may be produced by kyphosis of the spine, if this occurs before puberty. If the kyphosis is in the upper part of the spine a compensatory lordosis is developed below, and the pelvis is not affected. If the kyphosis is in the lower dorsal or lumbar region the top of the sacrum is displaced backwards, and the lower part forwards. The result is an increase in the antero-posterior diameter of the brim, but the

antero-posterior diameter of the outlet is reduced. There may also be some narrowing of the transverse diameter of the outlet, and the effect on the mechanism of labour is similar to that in the android or funnel-shaped pelvis (Fig. 158).



FIG. 156.—PELVIS FROM A PATIENT WITH OSTEOMALACIA. NOTE THE CRUMPLING UP OF THE BONES CAUSING GREAT DISTORTION OF THE PELVIS.

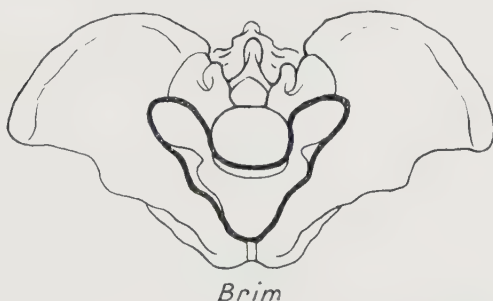


FIG. 157.—OSTEOMALACIC OR TRIRADIATE PELVIS.

The Spondylolisthetic Pelvis

The rare condition of spondylolisthesis appears to be familial, but a history of trauma may be obtained. It consists of a sliding forwards of the body of the fifth lumbar vertebra over the sacral promontory, and

it is usually accompanied by rotation of the sacrum as in the kyphotic pelvis. The displaced lumbar vertebræ partially occlude the pelvic brim, and may make normal delivery difficult or impossible. (Fig. 159.)

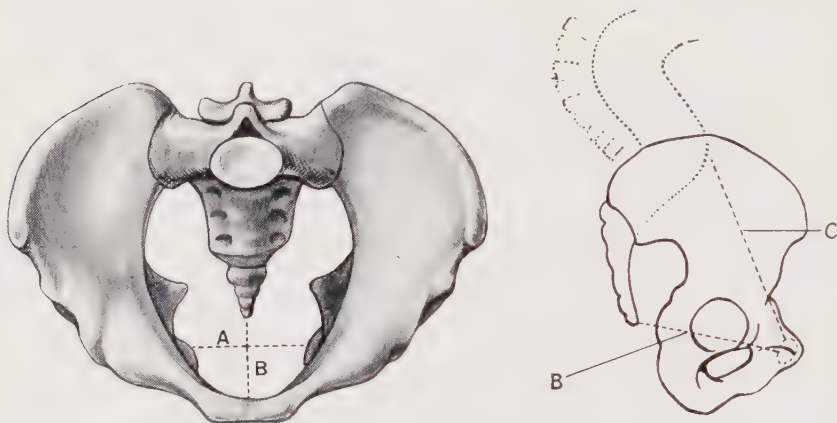


FIG. 158.—KYPHOTIC PELVIS.

Showing the diminished antero-posterior (B) and transverse (A) diameters of the outlet, and the increased antero-posterior diameter (C) of the inlet.

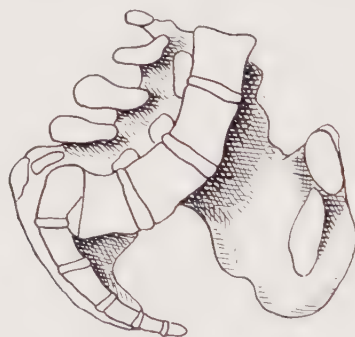


FIG. 159.—SPONDYLOLISTHETIC PELVIS.

Nevertheless the amount of forward dislocation of the lumbar vertebræ is often insufficient to cause any appreciable shortening of the true conjugate of the brim, and more than one normal labour may have occurred before the diagnosis is established.

The Oblique or Asymmetrical Pelvis

If one leg is shorter than the other as a result of injury, poliomyelitis, or hip disease, the pelvis tilts towards the affected side, and there is a compensatory scoliosis of the spine. If the condition has arisen before puberty considerable asymmetry of the pelvis may be produced

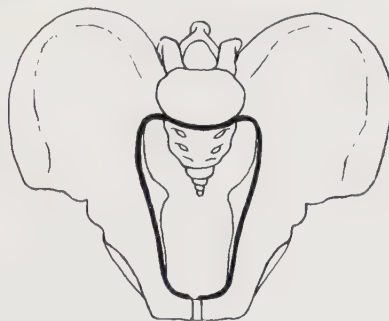
by the unequal distribution of the body-weight. An asymmetrical pelvis may also be produced by malunion of fractures of the pelvic bones, and finally the rare Nægele's oblique pelvis results from defective development of the lateral-mass of one side of the sacrum.



Brim

FIG. 160.—ASYMMETRICAL NÆGELE PELVIS.

In many asymmetrical pelves the contraction of one-half of the pelvis is compensated by enlargement of the other half, and the head may be accommodated without difficulty in the more roomy side of the



Brim

FIG. 161.—TRAVERSELY CONTRACTED, ROBERT'S, PELVIS.

pelvis. Disproportion or obstruction of labour may, however, occur, especially with the oblique pelvis of Nægele.

The Transversely Contracted Pelvis of Robert

In this exceedingly rare pelvis there is a congenital absence of both lateral masses of the sacrum, with synostosis of the sacro-iliac joints (Fig. 161). The transverse diameters of the pelvis are markedly contracted, and Cæsarean section is usually necessary if pregnancy occurs.

CHAPTER XXXIII

CEPHALO-PELVIC DISPROPORTION

DISPROPORTION between the foetal head and the maternal pelvis means either that the head is too large to go through the pelvis, or that it will only go through as a result of moulding of the head. The pelvis in most women is large enough to allow the foetal head to go through with room to spare. It is also possible that the size of the foetal head at term is in some way determined by the size of the maternal pelvis, so that in the absence of pelvic deformity the majority of labours will proceed without mechanical difficulty or disproportion. However, there are exceptions to this rule, and the obstetrician must not only look out for abnormalities of the pelvis, but in addition must endeavour to exclude disproportion in every patient, even though the pelvis is thought to be normal.

Disproportion may occur at the pelvic brim or in the lower pelvic strait, or outlet, and the problems connected with these two types of disproportion are very different. It is easier to assess the possibility of disproportion at the brim, because the foetal head can usually be used as a pelvimeter during the last month of pregnancy. Clinical examination and measurement of the pelvic diameters at the outlet must never be neglected, more especially as the foetal head cannot be used as a pelvimeter. Disproportion at the outlet may, however, be overcome more easily, firstly because the foetal head may already have undergone some moulding, and secondly because the antero-posterior diameter of the outlet may be capable of very slight enlargement. The lower part of the sacrum is joined to the ischial bones by the sacro-sciatic ligaments, which allow slight movement of the sacrum in relation to the forepart of the pelvis. Although this backward swing of the sacrum cannot increase the diameters of the brim, it may allow slight enlargement of the outlet.

The Diagnosis of Disproportion

Obstetric History.—The possibility of disproportion should be suspected when there is a history of a previous long labour or difficult delivery, with perhaps a stillborn child, or a previous Cæsarean section for disproportion. A prolonged labour with forceps delivery is not invariably due to disproportion, and is in fact more often due to abnormal uterine action ; similarly a previous Cæsarean section does not

necessarily mean that disproportion was present. The birth-weights of previous children, if any, should always be noted, but this is not an infallible guide to the expected birth-weight or size of the foetus in a subsequent delivery.

Examination of the Pelvis.—Some abnormality may be discovered on pelvic examination, and it is always necessary to assess by vaginal examination the brim, the cavity and the outlet.

(a) *Assessment of the brim* is difficult, because as a rule the sacral promontory cannot be reached. If the sacral promontory can be felt the diagonal conjugate, which is the distance between the promontory and the lower margin of the symphysis, should be measured (Fig. 162).

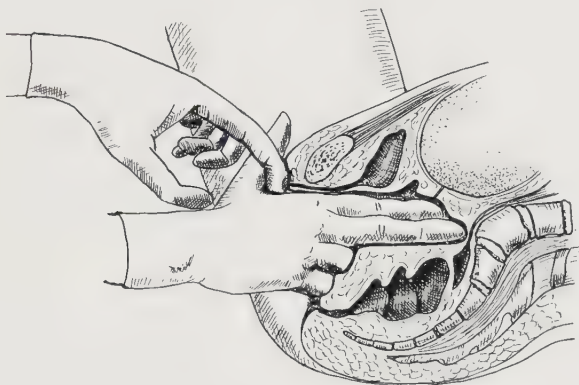


FIG. 162.—MEASURING THE DIAGONAL CONJUGATE.

The antero-posterior diameter of the brim or true conjugate is normally 1.25 cm. ($\frac{1}{2}$ inch) less than the diagonal conjugate, but this is variable, and the diagonal conjugate should measure 12 cm. ($4\frac{3}{4}$ inches).

(b) *Assessment of the cavity.* The anterior surface of the sacrum should be felt from above downwards. In some cases the concavity is marked, and the lower part of the sacrum may project forwards considerably; in other cases the upper part of the sacrum may be straight or even slightly convex. The antero-posterior diameter of the cavity is the distance between the junction of the second and third sacral segments and the middle of the posterior surface of the symphysis, but it may be assessed clinically by measuring to the lower border of the symphysis as with the diagonal conjugate.

(c) *Assessment of the lower pelvic strait.* The distance between the ischial spines normally 10 cm. (4 inches) is difficult to measure clinically but the spines should be found by sweeping a finger down the curve of the sacro-sciatic notch on each side, and with experience an impression

may be formed as to whether the inter-ischial spinous diameter is normal or not. The antero-posterior diameter of the outlet is measured from the sacro-coccygeal joint to the lower border of the symphysis, and the mobility of the coccyx should be noted. If the coccyx is fixed the antero-posterior diameter should be measured from the tip of the coccyx. It normally measures 13.1 cm. ($5\frac{1}{4}$ inches). The available antero-posterior diameter is lessened if the sub-pubic arch is narrow, and an attempt should be made to assess the sub-pubic angle.

The Fœtal Head.—The use of the fœtal head as a pelvimeter at, or after, the 36th week of pregnancy is of the greatest importance in the diagnosis of disproportion at the brim. It is an additional reason for attempting version in cases of breech presentation.

The head is said to be engaged in the pelvis when the widest transverse diameter has passed through the plane of the brim. Very little of the head can be felt on abdominal examination, and the examining fingers cannot be dipped below the presenting part. When the head is entirely above the brim, the fingers can easily be dipped below the head, which is said to be free, and can usually be moved a little from side to side. Sometimes the head is fixed, but not fully engaged.

If the head is found to be engaged in the pelvic brim during the last month of pregnancy, brim-disproportion is of course, excluded. If the head is not engaged or free above the brim an attempt should be made to cause it to engage. This may sometimes be achieved by direct pressure on the head, but this method may be fallacious. It is better to sit the patient upright, with the back supported by a back rest, as this posture will tend to fix the head or cause it to engage in the brim. The head is now palpated immediately above the symphysis pubis. It may now be found that the head is engaged, but if not it should be ascertained whether the head overlaps either the posterior border or the anterior border of the symphysis. Such overlap may still be due to other factors such as poor flexion of the head, but disproportion should be suspected if the head is not engaged in the sitting-up position. Disproportion can also be assessed during the last month of pregnancy by examination under an anæsthetic with the patient in the lithotomy position. This is known as Munro Kerr's method, and though effective, it is seldom used now, as it has been largely superseded by X-ray diagnosis of disproportion. Two fingers inserted into the vagina assess the descent of the fœtal head, when it is being pushed into the pelvic brim by the other hand *per abdomen* (Fig. 163). If the head cannot be made to engage, the amount of overlap in front of either the posterior or anterior border of the symphysis can be estimated; overlap can be caused by deflexion of the head, or may be minimized by asynclitism,

and it is therefore necessary to define the position of the head and make sure it is not badly flexed or asynclitic, when the degree of overlap is being assessed.

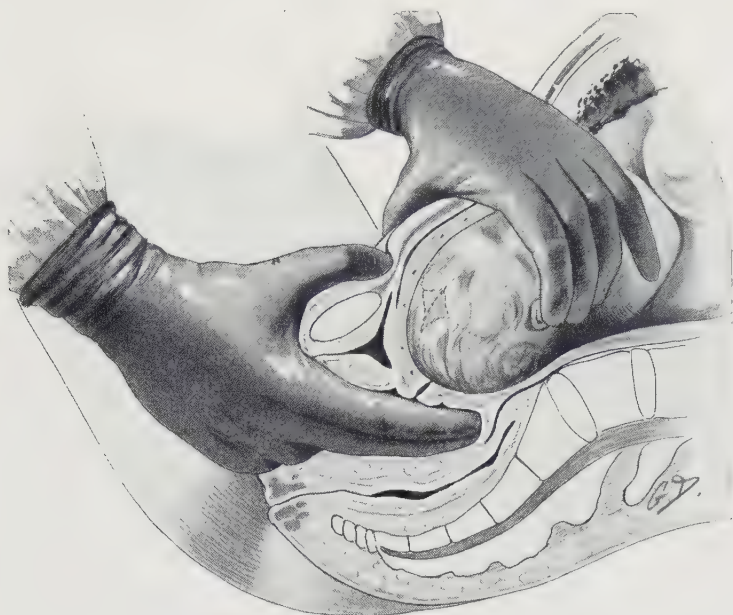


FIG. 163.—MUNRO KERR'S METHOD OF ESTIMATING THE RELATIVE SIZES OF THE MOTHER'S PELVIS AND THE CHILD'S HEAD.

Radiological Methods of Diagnosis

X-rays are a valuable aid in the diagnosis of pelvic contraction and disproportion, but it must be remembered that excessive exposure to X-rays can harm the foetus, and as few films as possible should be taken. X-rays of the pelvis should not be taken in the early months of pregnancy, when the foetus is most liable to be affected by X-rays; they are of more value in the last few weeks of pregnancy, when the foetal head can be compared with the pelvis.

Pelvic X-rays may give a more accurate picture of the shape and size of the pelvis than clinical examination, but they must never be allowed to supplant clinical examination of the pelvis. Measurement of the foetal head by X-rays should only be regarded as an approximation, and in some cases the position or attitude of the foetal head makes cephalometry quite inaccurate; for example it is out of the question if the head is in the fundus or in one or other iliac fossa.

X-rays may sometimes be of value during the course of labour, but it must be recognized that the result of a trial of labour cannot be

foretold by radiological examination, because it also depends upon the efficiency of the uterine action and the degree of moulding which the foetal head can safely undergo. Radiology should never replace routine clinical examination, but should be used only to confirm, or refute, the clinical suspicion of abnormality. The exclusion of disproportion is sometimes of great value, reassuring both obstetrician

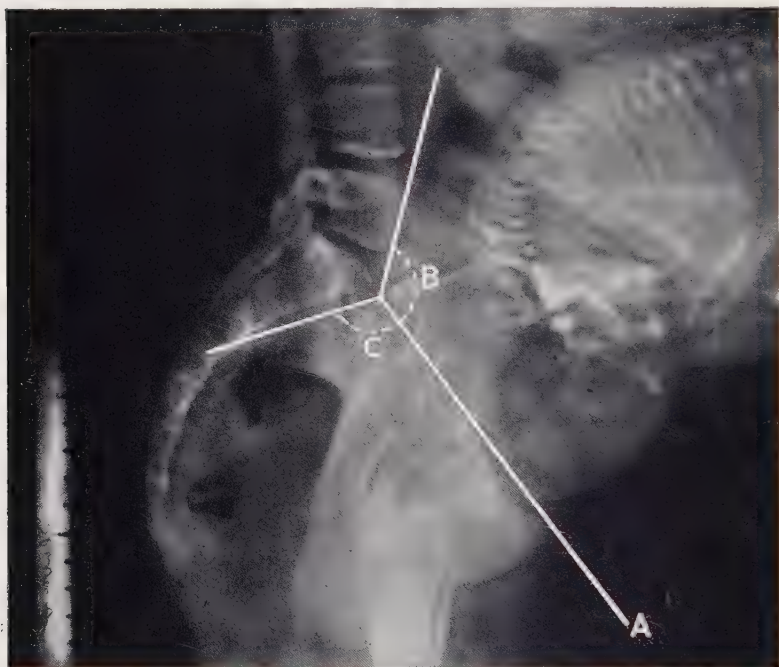


FIG. 164.—A LATERAL X-RAY OF THE PELVIS, THE FŒTUS IS IN AN OCCIPITO-POSTERIOR POSITION (Chassar Moir).

A, plane of the inlet. B, angle of inclination of the pelvic brim.
C, angle of inclination of the sacrum.

and the patient that vaginal delivery is feasible, but even so routine pelvic radiological examination of normal primigravidæ is quite unnecessary.

Radiological examination may be requested :—

1. When clinical examination of the pelvis at, or after, the 36th week suggests some abnormality in the shape or size of inlet, cavity or outlet.
2. If the patient has had a previous difficult forceps delivery, or a Cæsarean section for suspected disproportion.
3. If the foetal head is high in the last few weeks of pregnancy and does not engage in the pelvic brim, even when the patient sits or stands

up. In this case it is usually sufficient to take a lateral erect film, and if the head is seen to be engaged further films are unnecessary.

4. If there is a persistent malpresentation, such as a breech which cannot be turned, or a face or brow presentation. With a breech presenting the risk of irradiating the foetal gonads must not be forgotten.

Technique.—Many different techniques have been described, but the following views of the pelvis are of most value :—

1. *The lateral view* is taken with the patient standing erect, the fifth lumbar spine and symphysis being equidistant from the film, and the tube is centred just below the estimated mid-point of the true conjugate.



FIG. 165.—CEPHALO-PELVIC DISPROPORTION. ANTERO-POSTERIOR VIEW.

This is the most useful single film of the pelvis. It shows the length and curvature of the sacrum, and the curve of the birth canal, and it allows accurate measurement of the antero-posterior diameters of the brim, mid-cavity and outlet. From this film also the angle of inclination

of the inlet plane to the lumbar spine and sacrum can be measured (Fig. 170). It shows the level of the presenting part, and if the head presents, its degree of flexion or extension; the presenting diameter can be compared with the antero-posterior diameters of the pelvis, provided that the head is fixed in the mid-line.

2. *An antero-posterior view* is taken with the patient lying supine, and the tube is centred 7.5 cm. (3 inches) above the upper margin of the symphysis. This film shows the position and degree of flexion of the head, if it presents, and its relation to the pelvic brim; it also shows the amount of convergence or divergence of the side walls of the pelvis. It is of more value if a pair of stereoscopic films is taken, but in fact this view is useless for assessment of the size of the pelvis.

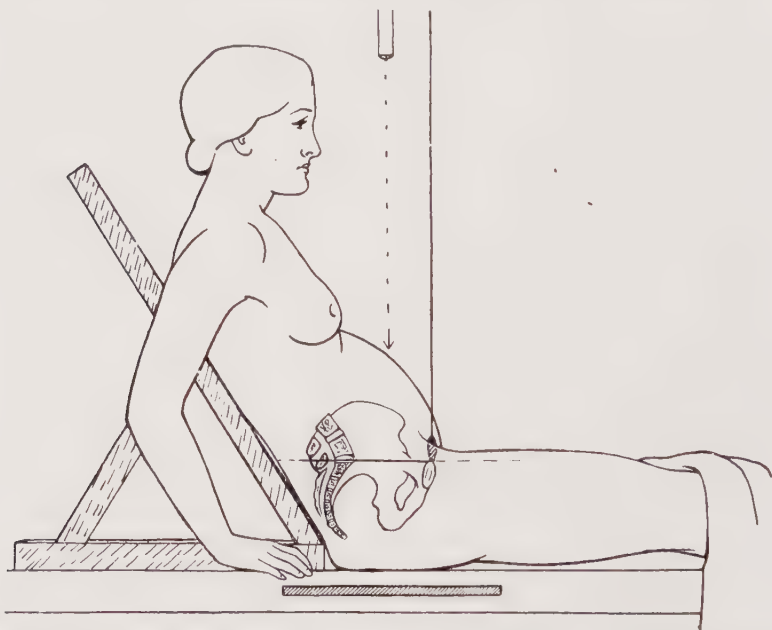


FIG. 166.—RADIOLOGICAL PELVIMETRY. TO SHOW POSITION OF THE PATIENT, FILM, X-RAY TUBE, AND PLUMB-LINE.

3. *A supero-inferior view* is taken with the plane of the pelvic inlet as near as possible parallel with the film, on which the patient sits. The top of the symphysis should be level with the tip of the fifth lumbar spine, and the tube is centred 6 cm. ($2\frac{1}{2}$ inches) behind the symphysis (Fig. 165). This film shows the shape of the pelvic inlet, and from it the diameters of the pelvic brim can be accurately measured, provided it was exactly parallel with the film (Fig. 166). In the majority of cases the inter-ischial spinous diameter can also be measured, although it is

on a plane much nearer to the film, and its position in relation to symphysis and sacrum can also be determined. Although this supero-inferior view is of considerable value, it is now usually omitted because of the dosage of X-rays needed to traverse the long axis of the uterus.

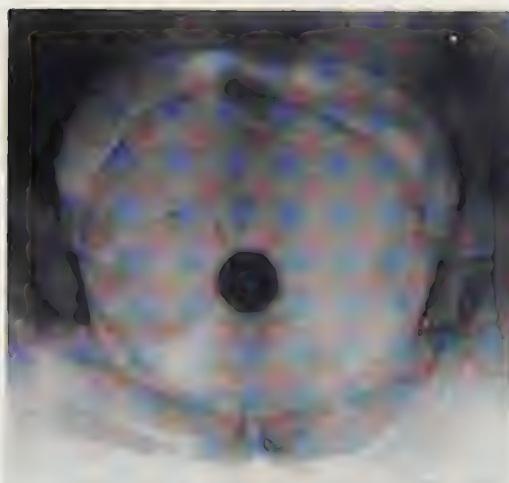


FIG. 167.—SUPERO-INFERIOR VIEW OF PELVIC INLET. THE GENERALLY CONTRACTED OR SMALL ROUND PELVIS.



FIG. 168.—OUTLET VIEW, SHOWING NORMAL SUB-PUBIC ARCH.

4. *A view of the outlet* is taken with the patient sitting on the table, with her body inclined well forwards, so that her abdomen rests between her separated thighs; the tube is centred over the sacrum, with a forward angulation of 10° , so that the central exit ray is in the middle

of the sub-pubic arch (Fig. 168). This film shows the shape of the sub-pubic arch and allows measurement of its angle, and of the inter-tuberos diameter. If the sub-pubic arch is narrow the head cannot emerge close to the symphysis, and from the film a point can be determined, some distance below the lower border of the symphysis, from which the available antero-posterior diameter of the outlet can be calculated, using a similar point on the lateral film.

Reconstruction Charts can be drawn from the tracings of these films, showing the true size and shape of the pelvic inlet, mid-cavity and outlet, and these are of great value in assessing the prognosis in borderline cases of disproportion.

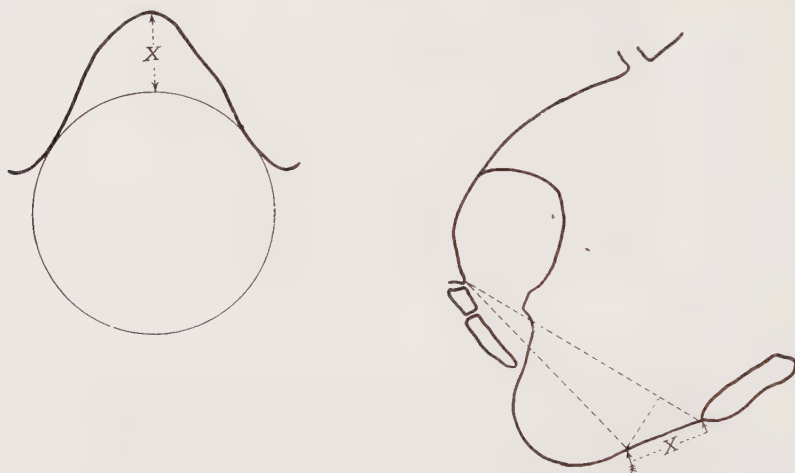


FIG. 169. -RECONSTRUCTION CHART OF OUTLET SHOWING THE AVAILABLE A.P. DIAMETER.

A circle with a diameter of 9 cm. ($3\frac{3}{8}$ in.), representing the size of an average foetal head at term is fitted into the sub-pubic arch: the distance between the nearest point on the circumference of this circle and the lower border of the symphysis pubis (x) is measured. The same distance (x) is marked on the lateral chart; the measurement to the sacral promontory gives the available antero-posterior diameter.

Value of X-Ray Pelvimetry and Cephalometry. Although knowledge may be gained by the more accurate radiological assessment of the pelvis and foetal head, it must be appreciated that it is not possible by radiological methods to forecast the outcome of labour. Neither the degree of moulding which the foetal head may undergo, nor the possible increase in size of pelvic diameters in labour can be determined radiologically. Although the diameters of the pelvic brim are capable of little expansion, the antero-posterior diameter of the outlet can probably be stretched to some extent. Furthermore, the outcome of labour will depend to a very large extent on the force and efficiency of uterine action. An efficient uterus may overcome a moderate degree of dis-

proportion, by causing flexion and moulding of the foetal head whereas inco-ordinate uterine action may cause prolonged and difficult labour, even when disproportion is known to be absent.

Radiology is useful in excluding disproportion; many patients might otherwise be treated by Cæsarean section for suspected but unproved disproportion. X-rays are also of value in the borderline group, in which some disproportion is present, but in which vaginal delivery should result with careful management; finally in the comparatively rare cases of gross pelvic abnormality the necessity for elective Cæsarean section will be confirmed by X-rays. Nevertheless the dangers of radiology must not be forgotten, and X-rays should not be taken without very definite clinical reasons, and the fewer films taken the better.

The Diagnosis of Disproportion during Labour

Although disproportion should be suspected if the head remains at or above the pelvic brim during the first stage of labour, it is not necessarily present. In multiparous patients, particularly, the head may remain high until the cervix is fully dilated, and then descend rapidly during the second stage of labour. Disproportion or malpresentation should also be suspected in cases of hypertonic uterine action. Marked caput formation with œdema of the cervix and over-riding of the parietal bones are diagnostic of disproportion at the brim during the first stage of labour. In some cases a large caput can be felt at the level of the ischial spines before the head has completely engaged in the pelvic brim. In addition there may be retention of urine and difficulty may be experienced in passing a catheter. X-rays are sometimes helpful during a trial of labour to determine whether the greatest transverse diameter of the head has passed through the plane of the brim, or whether there is sufficient moulding of the head to allow it to pass through (Fig. 170).

Disproportion at the outlet will cause delay in the second stage of labour, and as a rule the foetal head will be found in the position of deep transverse arrest at the level of the ischial spines. In the rare cases of disproportion at the pelvic outlet the diagnosis may be made only when forceps have been applied after manual rotation of the head, and it is found that undue force has to be used to effect delivery.

Treatment of Disproportion

There are several methods of treating a patient with disproportion, and it is therefore obvious that different views may be held in a particular case. The increased safety of the Cæsarean operation, due to chemotherapy, blood-transfusion and the lower segment technique, has greatly

increased its scope in the treatment of disproportion: it has entirely replaced the high forceps operation for obstruction at the brim, and few obstetricians now advocate or practice symphysiotomy. Craniotomy is never performed now on a living normal foetus; and finally Caesarean section may be safely accomplished in a patient when delivery



FIG. 170.—LATERAL VIEW OF THE PELVIS, SHOWING MOULDING OF THE FŒTAL HEAD DURING LABOUR.

The arrows point, respectively, to the sacral promontory and to the lower border of the symphysis pubis.

with the forceps has failed. Nevertheless it must be recognized that the maternal mortality of Caesarean section is higher than that of vaginal delivery, and it does not guarantee survival of the child. It should not, therefore, be lightly undertaken in cases of suspected but unproved disproportion.

Trial of Labour is the treatment of choice in patients with a minor or moderate degree of disproportion at the brim, particularly in a young primigravida with no complicating obstetric factors.

In this method of treatment labour is allowed to begin. The patient is carefully watched during labour in the hope that uterine contractions will cause sufficient moulding of the head to overcome a minor or moderate degree of disproportion ; the biparietal diameter of the foetal head may sometimes be reduced by as much as 1.25 cm. ($\frac{1}{2}$ inch) during labour. A trial of labour may terminate successfully in a spontaneous delivery or a low forceps delivery. If it fails it may be necessary to resort to Cæsarean section because of failure of labour to progress, or maternal or foetal distress. Cæsarean section is safer for both mother and child than the difficult and dangerous high forceps operation. Trial of labour should only be undertaken in a hospital where adequate facilities for Cæsarean section are present.

The management of a trial of labour requires careful attention to detail and the progress of labour must be carefully watched. Records should be kept of the maternal pulse-rate and the foetal heart-rate. The patient should be encouraged to expect a successful outcome, and should not be allowed to become aware that a trial of labour is proceeding, which may possibly end in Cæsarean section. The progress of the head through the brim is observed by abdominal palpation and vaginal examination. Vaginal examination must be performed when the membranes rupture, to exclude prolapse of the cord and to estimate the progress of dilatation of the cervix and descent of the head. Further vaginal examinations should be performed if it is thought that the head is not passing through the brim, to discover if signs of impending obstruction are present ; marked caput formation, œdema of the cervix and over-riding of the parietal bones should be looked for. In cases of doubt it may be helpful to have a lateral X-ray of the pelvis taken during labour, if facilities are available.

It is not possible to give a set time to the duration of a trial of labour, as the force and frequency of the uterine contractions are so variable. Labour should be allowed to continue so long as progress is being made, provided there is no foetal distress. The progress of labour is judged firstly by evidence of engagement and descent of the head on abdominal palpation, and secondly by continuing dilatation of the cervix and descent of the head on vaginal examination. Sometimes the head remains high for a considerable time during the early part of a trial labour, but descends through the brim without much difficulty when the membranes rupture and the cervix approaches full dilatation. The mother must be given sedative drugs during the first stage of labour, particularly if it is prolonged ; drinks of water or tea should be given as the patient desires, but food should be withheld as it is retained in the stomach, and is likely to cause vomiting if the patient has to be given an anæsthetic later on ; the bladder may need emptying by catheter

if the patient is unable to pass urine herself. Cæsarean section will become necessary if it is found that the head has become fixed in the brim and has undergone moulding, but does not descend through it in spite of strong uterine contractions. In such cases the cervix may become œdematous and does not feel closely applied to the presenting part. Sometimes it is necessary to terminate the trial labour by Cæsarean section because of a prolonged first stage of labour due to hypertonic uterine inertia, even though disproportion is of slight degree, and it should be undertaken without delay if signs of foetal distress become evident.

When the foetal head has passed through the brim into the pelvic cavity, the cervix will become fully dilated, and the second stage may terminate in spontaneous delivery. If, however, there is any maternal or foetal distress, delivery should be effected with the obstetric forceps.

Elective Cæsarean section should be considered :—

1. In all cases of marked disproportion due to gross pelvic abnormality, in which vaginal delivery is unlikely, or would be dangerous to mother or child.

2. In the borderline group in which some degree of disproportion is present, but it is considered unwise to submit the patient to a trial of labour, either because of her age or general condition, or because of some complicating obstetric factor, such as a breech presentation which cannot be turned. If the patient has previously had a difficult vaginal delivery, and particularly if the child did not survive, elective Cæsarean section would be indicated.

3. In patients who have had a previous Cæsarean section for disproportion, particularly if evidence of disproportion is again present. If disproportion is not found, normal labour and vaginal delivery may be allowed, preferably in hospital, but a careful watch must be kept in case of rupture of the uterine scar.

Trial of forceps is now considered to be correct treatment for minor or moderate degrees of outlet contraction. When the patient has been in the second stage of labour for about an hour, without any advance of the head, obstetric forceps are applied, preceded by manual rotation if necessary. If the head can be delivered with moderate traction, the delivery is completed *per vias naturales*. If this fails, an immediate lower segment Cæsarean section is performed, in preference to forceps delivery using extreme force.

Surgical Induction of Premature Labour has in the past been advocated and frequently practised for disproportion at the brim in the hope that the head of a premature foetus would pass through a contracted pelvis more easily than it would at term. Apart from the

risks inherent in prematurity the chief objections to this method of treating disproportion are the risk of intra-uterine infection, particularly if the onset of labour is unduly delayed, and the increased likelihood of uterine inertia. Furthermore it is now recognized that it is impossible, even with the help of X-rays, to determine the exact size of a foetal head which will or will not go through a particular pelvis, and treatment by trial of labour is therefore preferable. Surgical induction of labour may occasionally be considered in multiparæ, when it is known that the head passed through the brim with some difficulty in a previous labour. Surgical induction of labour is condemned in primigravidæ when only a minor degree of disproportion is suspected as experience has shown that following trial of labour most of these women deliver themselves without difficulty. Surgical induction is never indicated when there is marked disproportion.

Severe degrees of outlet contraction, necessitating Cæsarean section, are fortunately rare, and the forces of labour, or delivery with the forceps, will overcome minor degrees of outlet contraction. Surgical induction may sometimes be advisable in a multipara who has previously had a difficult forceps delivery because of outlet contraction, but a primigravida with suspected outlet contraction is best treated by trial of forceps.

Forceps delivery is the alternative treatment for most cases of outlet contraction in which the natural forces have failed to overcome the disproportion. The application of the obstetric forceps should be preceded by flexion and manual rotation of the head in cases of deep transverse arrest, or persistent occipito-posterior, unless Kielland's forceps are used to rotate and deliver. Traction on the forceps should be intermittent and should accompany uterine contractions. It is advisable to perform an episiotomy, as the backward displacement of the foetal head by a narrow sub-pubic arch is likely to cause laceration of the perineum.

Although delivery with the forceps may be necessary early in the second stage of labour if there is foetal distress, it is preferable to allow time for moulding to occur, and the less force which has to be used to effect delivery the better.

Craniotomy.—Perforation of the foetal head should never be necessary in a case of disproportion treated in hospital, but it may be necessary if the patient is admitted with obstructed labour and the foetus is dead. If the foetus is dead there should be no hesitation in performing craniotomy to make the delivery easier, even if the head is still above the pelvic brim. If the foetus is still alive Cæsarean section should always be preferred to craniotomy; even though the risk of a Cæsarean section late in labour is increased, it is probably no greater than the risk of craniotomy and extraction *per vaginam*.

CHAPTER XXXIV

TRAUMATIC LESIONS

RUPTURE OF THE UTERUS

RUPTURE of the uterus is a most serious condition. It generally occurs during labour but may also, though more rarely, occur during the later weeks of pregnancy.

CAUSES

During pregnancy the commonest cause of rupture of the uterus is a weak scar after Cæsarean section. In rare instances rupture of the uterus may occur after myomectomy or hysterotomy, or after perforation of the uterus with a curette.

Rupture of the uterus during pregnancy has also followed a direct blow on the abdomen, and perforating wounds may injure the uterus.

During labour rupture may be due to:—

1. Obstructed labour. In these cases rupture may be spontaneous or, more likely, follow manipulations carried out for the relief of the obstruction.

2. Intra-uterine manipulations, such as internal version or manual removal of an adherent placenta.

3. Forcible dilatation of the cervix. Rarely a cervical tear in a normal delivery may extend up into the body of the uterus.

4. The injudicious use of pituitary extract or ergot.

5. A weak scar in the uterus after Cæsarean section, or in rare instances after myomectomy or hysterotomy, or after perforation of the uterus with a curette.

6. Degeneration of uterine muscle, which is most likely to occur in women who have had numerous pregnancies.

PATHOLOGY

Ruptures of the uterus are divided into (1) complete or intra-peritoneal, and (2) incomplete or extra-peritoneal, depending upon whether the peritoneal coat is torn through or not. A tear into the broad ligament is not complete unless the effused blood bursts through into the peritoneal cavity.

In obstructed labour rupture of the uterus generally takes place in the over-stretched and thinned lower segment of the uterus, and may be limited to it, but sometimes spreads upwards or downwards. With the head over the brim of the pelvis the posterior wall of the uterus usually gives way, but with an oblique lie the transverse stretching tends to cause a lateral rupture. Although the over-stretched lower segment may give way as a result of the uterine contractions, the rupture more commonly results from operative measures undertaken to deliver the foetus, such as forcible dilatation of the cervix, version, delivery with forceps, or craniotomy. When the rupture is complete the foetus usually escapes into the peritoneal cavity, but if the presenting part is firmly fixed in the pelvis only part of the foetus will escape.

The life of the mother is threatened by shock and intra-peritoneal bleeding. There is also a high risk of peritonitis because rupture occurs in cases of prolonged labour, or after repeated examinations or intra-uterine manipulations have been made. In cases of obstructed labour the foetus is often dead before the rupture occurs, but in any case it will almost certainly perish if complete rupture occurs.

Rupture of a scar in the uterus usually occurs during labour, but may also occur in the later weeks of pregnancy. In this country a weak scar is now the commonest cause of rupture of the uterus; nearly all cases of rupture during pregnancy are due to this cause, and more than half of the cases of rupture during labour. Over-distension of the uterus, by twin pregnancy, for example, will increase the risk of rupture of a scar. Healing of a scar may be imperfect if gross sepsis occurs during the puerperium, or if the edges of the incision are inaccurately sutured. If the placenta is implanted over the scar the risk of rupture is increased; and also if section is repeated several times, when the incision of the latest operation is made through the scar tissue left by the earlier operations. During pregnancy a scar in the upper uterine segment is less secure than a scar in the lower segment. In labour also the lower segment scar is the safer, although occasionally rupture occurs. Until recently nearly all the cases of scar rupture followed classical Cæsarean section. Although the incidence of rupture has been reduced since the introduction of the lower segment operation, rupture of the lower segment now appears to be relatively more common, but this is only because classical section is now so rarely performed.

A Cæsarean scar in the uterus may stretch gradually, so that the wall in the region of the scar is only represented by attenuated and avascular fibrous tissue. For this reason, when the weak area finally gives way there is sometimes relatively little intra-peritoneal bleeding. The membranes bulge through the rent, and will eventually give way, when the foetus or placenta may pass through it.

SYMPTOMS AND SIGNS

Rupture due to direct injury to the abdomen.—In the rare cases of rupture due to direct injury to the abdomen, severe shock and abdominal pain, together with the history of the accident, will suggest the possibility of visceral injury. Precise diagnosis may be impossible without laparotomy, but in case of doubt this would be well justified.

Rupture through a uterine scar.—In cases of rupture through a uterine scar during pregnancy the history of the previous operation will be available. Occasionally the attenuated scar of a classical Cæsarean section may be palpable through a thin abdominal wall as a sulcus in the uterus, which bulges with uterine contractions and is tender. Rupture during pregnancy may be so gradual, and attended by so little bleeding, that the symptoms may at first be very slight, and the description 'silent rupture' has been applied to these cases. There is abdominal pain, often central and related to the region of the scar, but at first there may be little change in the general condition of the patient. If the rupture becomes complete and part of the uterine contents are extruded into the peritoneal cavity more severe pain and shock occur. The diagnosis is often difficult, and it may be necessary to observe the case for a short time before a conclusion is reached. Tenderness in the neighbourhood of the scar is on the whole the most useful sign; only in rare instances will free fluid in the peritoneal cavity or bulging of part of the foetus through the rent be evident. Pain due to rupture in pregnancy may be misinterpreted as pain due to the onset of labour.

Rupture of a scar more commonly occurs during labour, when the scar gives way more suddenly than during pregnancy, so that the symptoms are more dramatic, with severe pain and shock. Unless the contents of the uterus pass into the peritoneal cavity uterine contractions may continue. The possibility of rupture of the scar should always be considered if a patient who has had a Cæsarean section suddenly complains of severe pain during labour which is not synchronous with the uterine contractions. The accident does not usually occur after a long and difficult labour, and for that reason the patient's general condition is better, and the risk of infection less, than in cases of rupture due to obstructed labour.

Spontaneous rupture in obstructed labour.—The preceding labour will have been prolonged, or there will have been violent uterine action almost without intermission between the pains, so that the patient may be exhausted before the rupture occurs. There may be obvious signs of disproportion, or of a malpresentation such as a

transverse lie, although these signs may have been overlooked before the accident. At the moment of rupture the patient cries out and complains of a sharp pain in the lower abdomen. Soon after the rupture she presents symptoms of shock, her face becomes pale and drawn, and her forehead is covered with a cold sweat. The pulse becomes thready in character, and its rate becomes rapid. The blood-pressure falls. The signs of shock may not always appear at once; after an incomplete tear the symptoms are sometimes slight, and when the child is partly expelled through a complete rent hæmorrhage is controlled by retraction of the uterus onto that part of the child which is gripped by the uterine wall.

Vaginal hæmorrhage is usually slight or absent. On abdominal examination there is no constant sign. A bulge may be felt in the uterine wall, or if the foetus has completely escaped into the peritoneal cavity it may be felt beside the small retracted uterus. If the child is completely extruded uterine contractions may cease, but in other cases often continue. On vaginal examination no presenting part may be felt, unless the head is impacted in the pelvis.

Rupture after intra-uterine manipulations.—In these cases the patient is usually anæsthetized when the manipulation is taking place, so that the first evidence that anything is amiss may be a sudden deterioration in her general condition, either at the time, or later on as the effect of the anæsthetic passes off. In some cases the signs may not appear until a few hours after delivery.

In other instances the operator may discover the injury while his hand is still in the uterus. After any difficult manipulation it is wise to examine the uterus carefully to exclude any injury.

Extensive cervical lacerations.—In some respects these injuries resemble the previous group, as they are usually produced with the forceps at a difficult delivery, or if the cervix is not fully dilated, but they seldom extend far enough to open the peritoneal cavity. Brisk external hæmorrhage may occur (see p. 442), or a large hæmatoma may form in the broad ligament (see p. 448). Vaginal bleeding in the third stage of labour with an empty and firmly retracted uterus should suggest the possibility of this type of injury, which can be confirmed by digital examination.

Rupture due to ecbohic drugs.—Rupture of the uterus has followed the administration of pituitary extract or ergot before the delivery of the child, particularly when there was some obstruction which prevented rapid delivery. There should be less danger when syntocinon or pitocin is used as a dilute intravenous drip and the uterine contractions can be observed and controlled. It is wise to begin with a

concentration of not more than 1 unit per litre. Ergometrine intramuscularly, or by intravenous injection, during the crowning of the head or the delivery of the anterior shoulder is quite safe.

PROGNOSIS

The maternal mortality resulting from rupture of the uterus in cases of obstructed labour is very high, about 50 per cent., and is higher in the complete than in the incomplete variety. This high mortality is due to the fact that this accident usually occurs in cases of prolonged labour with much manipulation, often complicated by sepsis, and with inefficient obstetric aid.

The mortality following rupture of a Cæsarean scar is much less, about 5 per cent., as the accident does not usually follow prolonged labour or difficult manipulations, and the patient is usually confined in hospital, where the rupture is more quickly detected and immediately treated.

The prognosis for the child is bad, the foetal mortality in the cases following obstructed labour being about 85 per cent., but less (45 per cent.) in the cases of scar rupture.

Better obstetric care, earlier diagnosis of rupture, blood-transfusion, and the introduction of the antibiotics should reduce the maternal mortality. Dangerous manipulations are now less often performed and cases of obstructed labour are less often seen, but these difficulties are avoided by Cæsarean section, so that the increased risk of scar rupture must be set against this.

TREATMENT

Prophylactic Treatment.—Rupture of the uterus will be prevented by improvement in the standard of practical obstetrics, and in particular in the proper management of complications. Thus, disproportion must be recognized early, and labour must not be allowed to continue to the stage of obstruction. An oblique lie must be corrected at an early stage, but if the shoulder has become impacted, the liquor amnii has drained away, and the uterus become tightly retracted, version should not be attempted; decapitation is the correct treatment. The cervix must not be forcibly dilated; and manual removal of the placenta must be carefully performed, with an external hand guarding and indicating the level of the fundus.

A patient who has had a Cæsarean section or extensive myomectomy should be admitted to hospital for any subsequent delivery, where all facilities are available. However, the fact that a patient has already had one Cæsarean section does not mean that all subsequent pregnancies

must be terminated in this manner, provided that the first operation was performed for conditions other than disproportion. If she had a classical operation, and it is known that uterine infection followed the operation, elective section may be advisable, as it would be in the case of a woman who has already had two or more Cæsarean operations.

Treatment after Rupture has Occurred.—Before carrying out any major abdominal operation the condition of the patient should be improved by morphia, and if necessary by blood-transfusion.

Cases in which the whole or part of the fœtus has escaped into the peritoneal cavity.—These cases must always be dealt with by abdominal section.

Cases in which the tear is discovered after the birth of the child.—If the placenta is in the peritoneal cavity, it is inadvisable to attempt to drag it through the tear by traction on the cord, because this will enlarge the rent and increase the hæmorrhage. To deliver the placenta, the abdomen must be opened, the placenta removed and the tear sutured if in a favourable position; otherwise hysterectomy should be performed.

Cases in which the tear is confined to the broad ligament will not be diagnosed till after delivery. The diagnosis as to whether the tear involves the broad ligament only will be determined by passing the finger into the rent. The hæmorrhage in these cases can usually be arrested by packing the cavity in the broad ligament.

Tears opening the posterior fornix, if complicated by prolapse of bowel, must be sutured and drained or the bowel replaced and kept back by a gauze plug in the pouch of Douglas. These accidents are unlikely under modern conditions and if they occur are probably best treated by laparotomy. Where an efficient theatre is not available the methods previously described may be justified.

Treatment of the ruptured uterus at laparotomy.—Many cases are best treated by hysterectomy, as efficient suturing may be difficult and almost impossible if there is bruising or raggedness of the tissues involved. In the few cases with little bruising and an accessible tear, the rent should be excised and sutured. In cases of scar rupture it is often possible to excise the edges of the rent and resuture the uterus. Interrupted sutures are passed through the whole thickness of the uterine muscle and tied, and a finer continuous catgut suture is used to approximate the peritoneal edges. If the bladder is involved in the tear, its wall must be sutured in two layers and an in-dwelling catheter inserted.

ACUTE INVERSION OF THE UTERUS

Acute inversion of the uterus occurs only during labour. In this condition the body of the uterus becomes partially or completely turned inside out. The condition is rare and its frequency depends chiefly on the care with which the third stage of labour is conducted. Three stages of inversion are described :—

1. When the fundus bulges into the uterine cavity but does not protrude through the cervix.
2. When the fundus protrudes through the cervix.
3. When the inverted body passes completely through the os.



FIGS. 171 and 172.—INVERSION OF THE UTERUS.

FIG. 171.—Fundal attachment of the placenta with a furrow on the anterior wall at the point (a) where the inversion is starting.

FIG. 172.—The inversion almost complete with the cup-shaped depression in place of the rounded fundus.

In the latter two stages the fundus may prolapse through the vulva and lie outside the body. Inversion may take place either before or after separation of the placenta.

CAUSE

The commonest and most important cause is mismanagement of the third stage by the attendant pressing on the fundus of an inert

uterus, or pulling on the umbilical cord when attempting to remove the placenta. For the production of inversion of the uterus the uterine wall must be relaxed. It is possible that on very rare occasions the inversion may be spontaneous, if relaxation of the part of the uterine wall to which the placenta is attached permits this part to be carried down by a contraction of the rest of the uterus. The inversion may rarely be started by a short cord being dragged upon during an instrumental delivery in an interval between contractions.

SYMPTOMS AND SIGNS

The chief symptoms are shock, hæmorrhage, and the appearance of a swelling at the vulva. As a rule the shock is severe, and is greater than the loss of blood warrants; the amount of bleeding will vary according to whether the placenta is separated or not, and a mass will be present in the vagina or outside the vulva. Pain is variable. Unexplained shock during the third stage of labour should always suggest that inversion of the uterus may have occurred. In most patients there is extreme shock, and death may occur very rapidly; very rarely, the symptoms may be so slight that the patient does not seek medical advice till the uterus has involuted, and the condition of chronic inversion is present. The diagnosis is made by the body of the uterus being absent from its usual position and a rounded mass being felt protruding through the cervix.

PROGNOSIS

Acute inversion has a mortality of over 40 per cent. Shock is the chief cause of the high death-rate, but a free and persistent loss of blood is also a factor in patients in whom the placenta has separated.

TREATMENT

The patient's life is threatened by shock and by bleeding, and both of these will continue until the uterus is replaced, hence it is desirable that the uterus should be replaced at once. The fundus of an inverted uterus soon becomes œdematous, and the œdema causes the fundus to become larger, making replacement more difficult; this is an additional reason for immediate replacement. The mortality is higher if replacement of the uterus is delayed while treatment for shock is being carried out. As soon as the diagnosis is made the patient should be given morphia, 0·016 g., (gr. $\frac{1}{4}$) and anæsthetized. After cleansing the vulva, vagina and inverted uterus, the placenta, if attached to the uterus, is stripped off. The uterus is then grasped

in the hand and squeezed back into its proper position, the part which became inverted last being replaced first, and the fundus last of all; throughout the manipulation counter pressure is maintained upon the abdomen with the other hand. Pressure should not be made on the fundus so that it is replaced first, in which case four thicknesses of the uterine wall would have to be pushed through the constricting ring instead of two.

Another method of replacement is by intravaginal fluid pressure. This is carried out by means of a Higginson's syringe. A vaginal douche of dettol solution is administered and by closing the entrance of the vagina with the hand the intravaginal pressure is raised sufficiently to replace the uterus.

When the replacement is completed, further hæmorrhage should be prevented by the intravenous injection of pitocin and ergometrine. These drugs also improve the muscle tone and, therefore, tend to prevent a recurrence of the inversion. Recurrence may occur if the replacement is incomplete. The patient should also be treated for shock immediately the uterus has been replaced.

Should inversion be discovered some days after labour, an anæsthetic should be given, and an attempt made at reposition which will generally be successful. Should it fail, it is necessary to wait till involution is complete, when continuous pressure may be made on the fundus with Aveling's repositor, which is usually successful in reducing the inversion.

The treatment of chronic inversion of the uterus will be found in the Ten Teachers' "Diseases of Women".

LACERATIONS OF THE GENITAL CANAL

LACERATIONS OF THE CERVIX

Lacerations of the cervix occur frequently but are often overlooked as they rarely give rise to immediate symptoms.

Extensive lacerations of the cervix may occur in precipitate labour, in a cervix in which there is a cicatrix, when the forceps has been applied and strong traction exerted with the cervix incompletely dilated, or in rapid delivery of the after-coming head in breech delivery with incomplete dilatation of the cervix.

When the cervix is deeply lacerated there may be continuous hæmorrhage during or after the third stage of labour, although the body of the uterus may be well retracted, and the bleeding will continue until the laceration is sutured. To do this the patient is anæsthetized and the anterior and posterior lips of the cervix seized with sponge

forceps and drawn well down. Interrupted catgut sutures are inserted, passing through the thickness of the cervix. After the sutures are tied the hæmorrhage ceases.

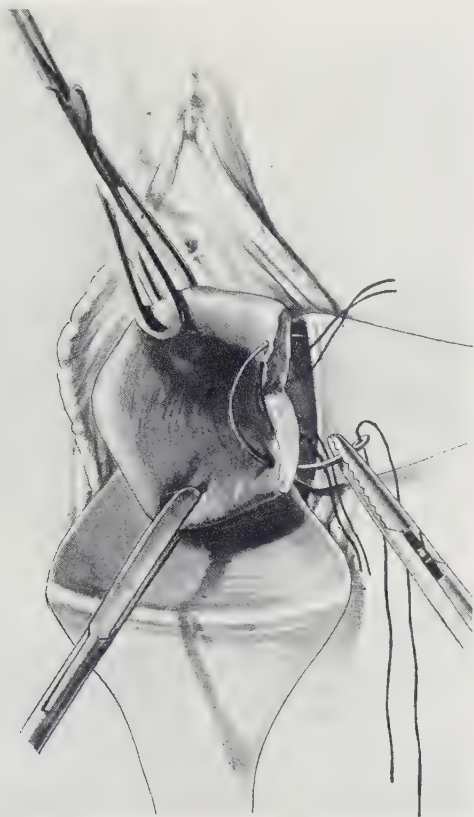


FIG. 173.—THE REPAIR OF A TEAR OF THE CERVIX BY INTERRUPTED CATGUT SUTURES.
The cervix is depicted outside for the sake of clearness.

LACERATIONS OF THE PERINEUM AND VAGINA

The first degree of tear involves the anterior part of the perineum and the posterior wall of the vagina, but the tear may be overlooked if the labia are not separated and the vaginal walls examined.

The second degree of tear involves the perineum up to the external sphincter with a corresponding tear in the vagina.

The third degree (complete) tear is of greater extent and includes the anal sphincter, and usually also extends for an inch or more up the anal canal.

It is important to realize that an extensive tear may occur in the vagina without a tear in the perineum and in consequence the vaginal walls should always be carefully inspected after delivery, in order that these vaginal tears may be sutured immediately.

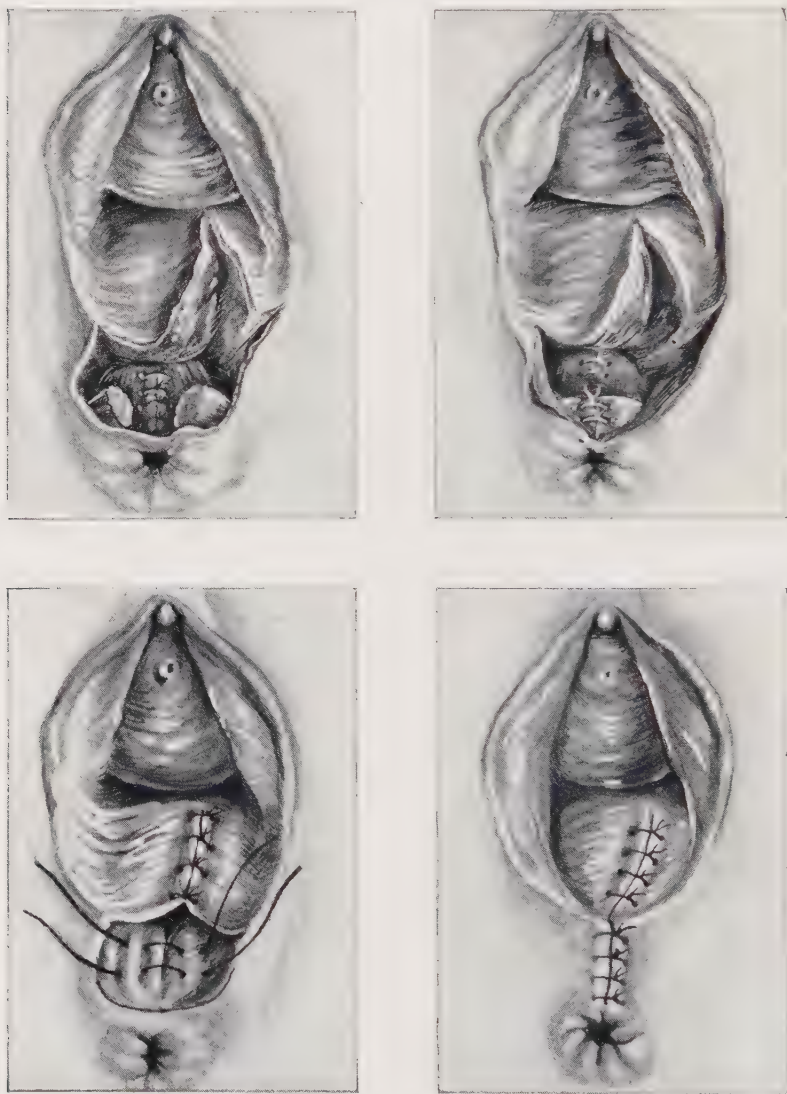


FIG. 174.—COMPLETE PERINEAL TEAR AND REPAIR.

Treatment of First and Second Degree Tears.—It is important to suture all perineal lacerations immediately to prevent any

infection of the raw surface. Deep lacerations involving the levatores ani lead to weakness of the pelvic floor, which may be followed later by vaginal or uterine prolapse.

The vaginal tear is first sutured with interrupted sutures of catgut passing right down to the depth of the wound in order not to leave any dead space. The tear of the perineum is then sutured in like manner with catgut for the buried sutures and terrylene for the skin. These are best sutured after the delivery of the placenta. The



FIG. 175.—SECOND DEGREE PERINEAL TEAR.

repair should be done carefully and accurately. The patient will have a general, pudendal or local anæsthetic. Local anæsthesia e.g. 1 per cent. lignocaine is suitable for first and the second degree tears but general anæsthesia is advisable for complete perineal tears. Extensive lacerations are best repaired in hospital. Except where a hospital is not available a complete perineal tear should not be repaired in the patient's home.

Treatment of a Complete Tear.—The operation should be done in a properly equipped theatre with a good light and with the help of

an anæsthetist, assistant and theatre sister. This may seem unduly fussy as many of these cases are treated at home. The results depend on meticulous work. If carefully sutured the tissues heal very well when the operation is done soon after delivery, but, if they fail to heal the patient will have to undergo a much more difficult operation later, or will suffer from rectal incontinence.

The anal mucosa is first sewn with interrupted No. 00 catgut sutures on a half circle 30 mm. intestinal needle. The knots may be tied inside the bowel lumen or having passed through the muscular coats only the knots are tied on the outer side so as to invert the torn edges of the rectum towards the lumen of the bowel. The superficial and deep external sphincter muscles are united with No. 0 catgut. The levatores ani and tissues of the perineal body are united with interrupted catgut sutures to avoid leaving any dead space and finally the vagina is sutured with interrupted No. 1 catgut and the perineal skin with terrylene.

After Treatment of Perineal Tear.—The perineal surface is swabbed with hibitane or cetavlon and should be kept as dry as possible. Sulphonamide and antibiotic powders may help. In third degree tears the patient is given 1 tablespoonful of liquid paraffin three times a day from the second or third day. This will produce a leakage of paraffin from the anus and will soften the fæces. Purgatives and enemata must be avoided. If the patient suffers from inability to pass flatus a soft rubber catheter should be carefully inserted into the anal canal. If she has difficulty with micturition it is wise to insert an indwelling catheter for 3 or 4 days.

FISTULÆ

Fistulæ may occur as the result of pressure by the presenting part in a case of prolonged labour, or by direct trauma during operative procedures. The pressure is generally caused by the head, as the breech is not sufficiently hard to cause damage.

If the head is delayed above the brim in obstructed labour, prolonged pressure on the uterine wall against the symphysis pubis or the promontory of the sacrum may cause a local anæmia and subsequent necrosis, but it is rare for this to cause a vesico-uterine fistula. It is much more common for the head to be arrested in the pelvic cavity by some moderate degree of general contraction of the pelvis, or a large head, and for the pressure to cause sloughing of the anterior vaginal wall, with the formation of a vesico-vaginal fistula. A fistula in the anterior wall is much more common than one in the posterior wall.

A fistula in the posterior wall may be caused by direct trauma, *i.e.* from slipping of the forceps or destructive operations such as craniotomy. The only common cause of a recto-vaginal fistula is a complete tear of the perineum extending into the recto-vaginal septum, followed by healing of the superficial and external part only.

Depending on the position of the fistula the patient passes urine, or flatus and fæces into the vagina. If due to a laceration the symptoms are manifest soon after delivery but, if due to necrosis following



FIG. 176.—DIAGRAM TO SHOW POSITIONS OF FISTULÆ.

A, Vesico-cervical fistula.

B, Vesico-vaginal fistula.

C, Urethro-vaginal fistula.

D, Recto-vaginal fistula.

C is a very rare form of fistula and would not result in incontinence like A and B, but only in urine dribbling through the vagina during micturition.

prolonged pressure, the symptoms do not usually appear till the 8th to the 10th day. On examination it is found that there is a hole leading into the bladder or rectum. Generally the destruction of tissue is greatest on the vaginal surface, and it sometimes happens that when this wound granulates the fistula heals. Unfortunately this is not always the case, and it will then be necessary to perform some plastic operation at a later date. Attempts should not be made to close these fistulæ till at least 4 months after the birth of the child.

HÆMATOMA OF THE VAGINA AND VULVA

Although it is rare this is a serious complication of pregnancy and labour, and is usually due to the rupture of varicose veins from the increased tension therein during the second stage of labour. It may be due to injury during delivery by the forceps. The patient complains of increasing pain in the neighbourhood of the lesion. The signs following rupture of the vein may only appear several hours after the child is born, as the escape of blood is prevented, for the time being, by the counter-pressure of the head.

The hæmatoma presents as a tender, œdematous swelling, purple in colour which spreads downwards and occupies one or other side of the vulva. Less frequently, the effused blood may track upwards, in which case the swelling will be found by the side of the vagina.

As a rule the blood is eventually absorbed, though occasionally it may become infected with resulting abscess-formation.

Treatment.—If the hæmatoma is noticed before the birth of the child, delivery should be effected as quickly as is consistent with the safety of the mother and child. If the vein has ruptured externally, it will be necessary to stop the hæmorrhage by ligature.

If the tension of the swelling is great it should be incised, the clot turned out, and the torn vein, if it is seen, should be ligatured. Firm pressure must then be made by a dressing and bandage.

If the hæmatoma suppurates, the swelling must be incised and efficiently drained.

BROAD LIGAMENT HÆMATOMA

In rare cases the hæmatoma is partly below and partly above the levatores ani and, therefore, may spread into the base of the broad ligament, between the uterus and the bladder or by the side of the rectum. The cause of the effusion of blood is most often a pressure necrosis of the wall of a vein which gives way either before, during or after labour. It may be associated with an extra-peritoneal rupture of the uterus. Most frequently the bleeding occurs immediately after labour, so that the hæmatoma is discovered a few hours or days later. If the blood extravasation extends above the levatores ani muscles it can be felt only on bimanual examination. It may be large enough to be palpable on abdominal examination, and the uterus is then displaced upwards and to one side.

A broad ligament hæmatoma usually undergoes gradual absorption, more or less time being taken during the process, according to the amount of effused blood. Occasionally the blood-clot becomes infected

and suppurates, especially if it is associated with a small external wound, but this complication is not frequent. Nearly all the fatal cases have been the result of septicæmia following infection of the hæmatoma in criminal abortion.

Treatment.—Penicillin, or other antibiotics, may be given to try to prevent infection of the hæmatoma. A hæmatoma spreading up into the broad ligament should never be incised unless there is evidence of infection. When an abscess forms it should be opened where it points.

CHAPTER XXXV

ANTEPARTUM HÆMORRHAGE

THE term antepartum hæmorrhage is applied to bleeding occurring from the placental site at any time after the 28th week of pregnancy and before the birth of the child.

Hæmorrhage may also occur during pregnancy from an erosion, polypus, carcinoma of the cervix, or from a varix of the vulva. All these conditions may cause bleeding during pregnancy and labour, but such hæmorrhage is not usually implied by the term antepartum hæmorrhage.

As defined above, antepartum hæmorrhage may be divided into two classes :—

1. Hæmorrhage due to the partial separation of a placenta normally situated on the upper segment of the uterus. This is called *accidental hæmorrhage*.

In these cases labour may progress without further bleeding.

2. Hæmorrhage due to the partial separation of a placenta abnormally situated on the lower uterine segment (placenta prævia). This is termed *unavoidable hæmorrhage*.

In this class of case the placenta is so situated that hæmorrhage is inevitable when the lower segment becomes dilated in labour. The hæmorrhage here is the reverse of accidental, it is unavoidable. The term accidental thus has no connexion with the same word used to denote trauma, although trauma may cause hæmorrhage. A correct diagnosis between accidental and unavoidable hæmorrhage is important because the treatment depends upon it.

ACCIDENTAL HÆMORRHAGE

VARIETIES

1. Revealed. 2. Concealed. 3. Mixed.

Owing to the separation of a portion of the placenta from its uterine attachment, part of the wall of the intervillous space is removed and maternal blood escapes from the opened sinuses. This blood may track down between the membranes and the wall of the uterus and so escape at the cervix (*revealed accidental hæmorrhage*), or may remain inside the uterine cavity (*concealed accidental hæmorrhage*).

Most often the hæmorrhage is partly concealed and partly revealed : this is *mixed concealed and revealed hæmorrhage*.

CAUSE

Clinically it is possible to differentiate two types ; the more serious group in which the hæmorrhage is associated with pre-eclampsia ; the other, in which evidence of pre-eclampsia is not found, is very seldom attributable to an accident in the sense of direct injury or trauma. In many cases no cause can be discovered. The toxæmic group of accidental hæmorrhage accounts for 20 or 30 per cent. of cases, but includes patients with toxæmia complicating essential hypertension or chronic

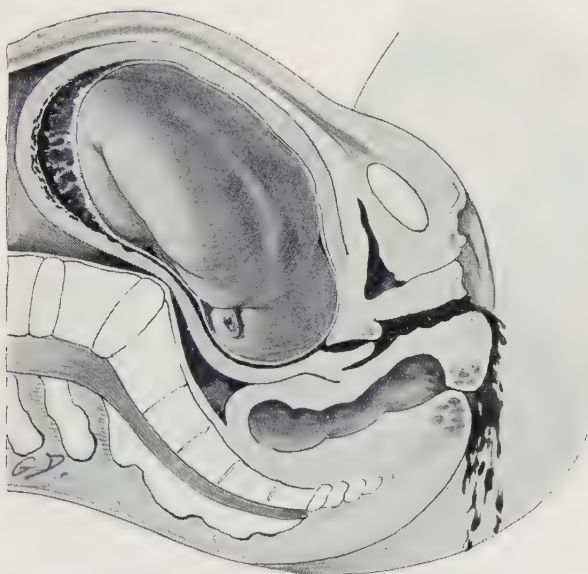


FIG. 177.—REVEALED ACCIDENTAL HÆMORRHAGE.

nephritis. In some cases the signs of toxæmia are not present until after the occurrence of a concealed hæmorrhage. Detachment of the placenta may also occur during an attempt at external version when injudicious force has been used.

The most serious variety of accidental hæmorrhage is that in which the blood remains in the uterus and is not expelled into the vagina. The majority of these cases are associated with a state of severe toxæmia. A systolic blood-pressure of 160 mm. Hg and a diastolic pressure of 100 are not uncommon and the urine may be laden with albumin and there may be œdema. The reason for the inability of the uterine musculature to contract, or even to maintain its normal tone, is apparent

when such cases are examined post-mortem or at the time of operation. Numerous small hæmorrhages are seen in the substance of the uterine muscle. Such extravasations will destroy a large number of muscle fibres and the contractile power of the uterus is further greatly weakened. As in the case of toxæmia, concealed accidental hæmorrhage is usually seen in the latter part of pregnancy.

SYMPTOMS AND SIGNS

Revealed Accidental Hæmorrhage.—With or without any obvious exciting cause the patient notices blood coming from the vagina. There may be slight abdominal discomfort and tenderness over the placental site.

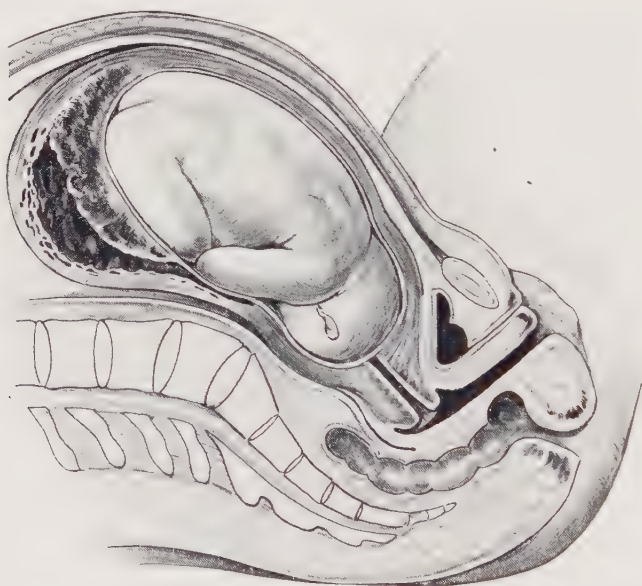


FIG. 178.—CONCEALED ACCIDENTAL HÆMORRHAGE.

A collection of blood can be seen between the placenta and uterus and below between the chorion and uterus, but blood has not reached the external os.

The presentation is usually a vertex with the head of the child in the pelvic cavity; the foetal heart may or may not be heard. The amount of placental separation will determine the prognosis to the child. A vaginal examination should not be done unless it is absolutely necessary to differentiate between this condition and placenta prævia. In such circumstances the examination must be made in an operating theatre prepared for a Cæsarean section if it proves to be a placenta prævia. The case is diagnosed as revealed accidental hæmorrhage

because the placenta cannot be felt. The amount of blood loss varies considerably but is seldom very great except in cases of hypofibrinoginæmia.

On vaginal examination, friable smooth blood-clot may fill the vagina and cervix, but the placenta cannot be felt. The amount of blood lost varies from a slight show, which the patient may compare with a menstrual period, to a violent flooding.

Concealed Accidental Hæmorrhage.—The symptoms and signs naturally vary with the severity of the case. In the extreme cases, the gravity of the patient's condition may be out of all proportion to the amount of blood effused into the uterus. This is ascribed to shock from generalized or localized over-distension of the uterus.



FIG. 179.—CONCEALED ACCIDENTAL HÆMORRHAGE AT END OF SECOND STAGE.

The placenta and a part of the membranes are separated from the uterine wall by a mass of blood-clot.

The clinical picture is one of internal hæmorrhage with the added effects of the uterine distension and shock.

The signs of internal hæmorrhage are of great importance, being the best indication of the amount of bleeding. In severe cases the pulse becomes very rapid and feeble, the skin is ashen grey in colour, cold and clammy. The blood-pressure is low and there may be oliguria. Air-hunger may be present. The over-distension of the

uterus gives rise to severe and constant abdominal pain. The uterus is larger than would be expected for the period of gestation reached and more globular in outline. It has a hard wooden consistence and is extremely tender. Contraction or relaxation cannot be detected, the foetal outlines cannot be made out, and the foetal heart cannot be heard. Examination *per vaginam* will usually show that the cervical canal is still closed. If there has been sufficient uterine action to start dilatation there will probably be some blood escaping externally and the case will then become one of the mixed variety of accidental hæmorrhage.

Should the loss of blood be smaller, the symptoms are correspondingly less severe and may be ascribed by the patient, and by her doctor, to an attack of colic of some nature. The patient complains of a sudden attack of abdominal pain and at the same time feels faint and suffers from nausea. She looks ill, her mucous membranes are pale, and the pulse-rate is raised. An abnormality may not be discovered on abdominal examination, except that palpation of the uterus elicits tenderness, usually localized to the placental site, and if a sufficient area of placenta has been detached, the foetal heart may be inaudible. A correct diagnosis is important as such a patient is likely to have a recurrent and more serious hæmorrhage. Albumin is usually present in the urine.

Mixed Concealed and Revealed Accidental Hæmorrhage. —

This form partakes of the characteristics of both, and includes the less severe cases of concealed hæmorrhage and the more severe cases of revealed hæmorrhage. The symptoms and signs may be those of concealed hæmorrhage with some external loss, and generally some dilatation of the cervix; or there may be external hæmorrhage with little or no evidence of distension of the uterus by retained blood, although after delivery, a quantity of dark blood found behind the placenta and membranes will show that concealed bleeding has occurred. In those cases in which the contractile power of the uterus is absent the hæmorrhage will be entirely concealed; when the contractile power is present but feeble some blood will be expelled, but much more retained; when the contractile power is active, little will be retained and most of it will be expelled. Albumin may be found in the urine, the blood-pressure may be raised and œdema may be found in the situations usual in toxæmia.

The severity of a case with external hæmorrhage must never be judged solely by the amount of blood lost *per vaginam* but by the general condition of the patient. A trifling external loss may be accompanied by serious internal hæmorrhage.

DIAGNOSIS

Revealed Accidental Hæmorrhage.—Revealed accidental hæmorrhage has to be diagnosed from unavoidable hæmorrhage. This can only be done for certain by failing to feel the maternal surface of the placenta through the internal os. As will be described in the treatment of unavoidable hæmorrhage it is dangerous to make this examination unless it is made in an operating theatre with preparations for dealing with whatever may be found. Unavoidable hæmorrhage is suggested by a history of recurrent attacks of bleeding, by the absence of signs of toxæmia, by a malpresentation and an unduly high presenting part. “

After delivery the diagnosis can be confirmed by examining the membranes, as the hole through which the child is delivered is within 7·5 cm. (3 inches) of the placental edge if the case was one of placenta prævia.

Concealed Accidental Hæmorrhage.—Here the diagnosis is more difficult. It is possible to confuse concealed accidental hæmorrhage with tonic retraction of the uterus; but if it is remembered that in tonic retraction labour is advanced and the uterine contractions are strong, that the uterus is not larger than normal, that it is not globular but is moulded to the shape of the child, and that the membranes are ruptured, such a mistake should be impossible.

The diagnosis must be made from cases of intra-peritoneal hæmorrhage, due to advanced ectopic gestation, to spontaneous rupture of the uterus, or to acute hydramnios. These, although rare complications of pregnancy, closely resemble accidental hæmorrhage of the concealed variety. They must be diagnosed by the history and on the physical signs present in each case. Other conditions complicating pregnancy such as torsion of the pedicle of an ovarian cyst, volvulus, intestinal obstruction, and acute appendicitis may have to be considered during the early stages of a concealed accidental hæmorrhage.

PROGNOSIS

The most important factor in the prognosis is the contractile power of the uterus. If the uterus can be made to contract and retract without delay, recovery is almost certain. Other factors are the severity of the accompanying toxæmia, the degree of shock, and rapidity and amount of the blood loss, and the occurrence of anæmia.

Death occasionally takes place from shock with or without external bleeding before the patient can be delivered. Owing to the fact that uterine inertia is usually marked (especially in the

concealed form) the patient may succumb after delivery to postpartum hæmorrhage. Prolonged loss of blood with intra-uterine foetal death are important causes of hypofibrinogenæmia and this may also cause severe postpartum hæmorrhage.

The prognosis for the child is bad. About 80 per cent. do not survive. This is due to (a) asphyxia from placental separation; (b) toxæmia; (c) prematurity.

TREATMENT

All cases of antepartum hæmorrhage should be admitted to hospital. In severe cases this is essential, in less severe cases the diagnosis is often uncertain and placenta prævia cannot always be excluded. A vaginal examination should not be made before the transfer of the patient to hospital (see p. 467). In cases with severe shock transfusion of blood or dextran, and an injection of morphia, should be given before moving the patient.

Revealed Accidental Hæmorrhage.—Since this term includes cases which vary in severity from a slight loss of blood to a profuse flooding, it will be seen that no single method of treatment will be applicable to all cases, which may be divided into two groups, according to the severity.

Slight Cases.—If the amount of bleeding is only slight and the pregnancy is still some weeks short of term, the best treatment to adopt is that which is employed in cases of threatened miscarriage, viz. to temporize in the hope that the bleeding will cease and the pregnancy continue to term. Before deciding to temporize, it is important to make sure that there is no evidence of concealed hæmorrhage by noting that the uterus is soft, not tender or tense, and that the pulse-rate is not much quickened. This temporizing, in the interests of the child, means keeping the patient absolutely at rest in bed and administering sedatives. Purges and enemata, which might induce or increase uterine contractions should be avoided. In the absence of further contractions, it is possible that the bleeding vessels in the exposed part of the placental site will become thrombosed and that further bleeding will not occur. Such treatment is frequently successful; the bleeding ceases and the pregnancy continues to term. The appearance of the placenta in such cases shows that part of it had been detached too soon, being brown, shrunk, and more solid than the rest, and having old blood-clot adherent to it.

Cases of Moderate Severity.—This group consists of cases in which the bleeding, though not of such severity as to threaten immediate

danger to life, is too copious to justify an attempt to prolong the pregnancy in the interest of the child which may already be dead. If there are good contractions active treatment is not necessary. The object of treatment is to get the uterus empty, contracted, and retracted with as little bleeding as possible and without added risk to the mother. This end can best be achieved by allowing the uterus to empty itself. The third stage should be conducted with care, an intravenous injection of ergometrine (0·5 mg.) being given during the birth of the head and intra-muscular ergometrine 0·5 mg. immediately after. On the other hand, in cases of revealed hæmorrhage of moderate degree, if the uterus is not contracting strongly, the action of the uterus should be stimulated by low rupture of the membranes and the application of a tight abdominal binder. The escape of liquor allows the uterus to retract more efficiently, and helps to control the bleeding, and the descent of the head on to the lower segment stimulates uterine contractions. If strong and regular contractions do not follow a pitocin or syntocinon drip should be set up.

Cæsarean Section.—This operation is sometimes justified in the interest of the fœtus. It should never be performed in the presence of severe maternal shock. It would be justifiable in a case with a viable fœtus and fairly severe bleeding. Such cases are not common, because the fœtus is sometimes dead or premature. Cæsarean section is not required in cases with slight bleeding unless there is evidence of fœtal distress.

Mixed Concealed and Revealed Accidental Hæmorrhage.—Severe accidental hæmorrhage does not occur in the presence of good uterine retraction. Because the uterine contractions are poor in cases of severe hæmorrhage there may not be much dilatation of the cervix. In cases in which a large amount of blood has been lost the uterus not only does not, but cannot contract. In these cases the child is almost certainly dead, and anything that is done is in the interest of the mother alone. It cannot be impressed too strongly on the student that any method of treatment which includes rapid delivery is likely to be fatal to the mother. She is already in a state of toxæmia as well as collapse from loss of blood, and the additional shock which is entailed by rapid dilatation of the cervix and delivery by the forceps, or by version, even if little further bleeding occurs after the treatment is begun, would be sufficient to cause death either immediately or within an hour or two of delivery. The essential points in the treatment of such a case are to stop the hæmorrhage at once and to tide the patient over the next few hours, treating the collapse and the effects of loss of blood before taking any active steps to deliver the fœtus.

The membranes should be ruptured, and a pitocin drip set up. Whether these measures induce uterine contraction or not is a matter of little moment if they stop the bleeding in the case of a collapsed patient, and the uterus is not likely to become active until the patient's general condition has improved. Measures must be adopted to combat the collapse, by warmth and blood-transfusion as soon as it can be arranged. As the woman's condition improves labour may begin and end spontaneously. Labour is usually easy as the patient is often a multipara and the foetus small. If the patient's condition improves the onset of labour may be awaited. Cæsarean section should never be performed if the patient's condition is poor and in consequence the operation has little place in the treatment of this condition.

Concealed Accidental Hæmorrhage.—Most cases of concealed accidental hæmorrhage are very serious, because the patient is collapsed as a result of the loss of blood and the painful distension of the uterus. The first essential is to treat the shock and not to attempt to deliver the child before this has been done.

The patient must be given an immediate injection of morphia, 0·015 g. (gr. $\frac{1}{4}$). The foot of the bed may be raised. The room should be as quiet as is possible and the patient should not be moved until severe shock has been treated by blood-transfusion and the injection of morphia. A flying squad should be called. If the patient's condition is poor and facilities for blood-transfusion are not available, dextran or other plasma substitute may be used, or failing that, intravenous saline, but dextran should not be used until blood is taken for grouping. A note is made of the girth of the abdomen at a marked level and the height of the fundus is likewise marked upon the skin. Following these steps the condition of the patient is observed, hour by hour, and she must not be left. A further injection of morphia (0·01 g.), gr. $\frac{1}{6}$ must be given if the pain is not relieved.

As the state of shock passes off a steady and marked improvement nearly always occurs. Further treatment must depend on the knowledge that the hæmorrhage is of the concealed variety, owing to the fact that the tone and contractile power of the uterus are so poor that it is unable to expel the blood. In addition treatment will be influenced by the parity of the patient and by the duration of the pregnancy. The majority of these patients are multiparous women, and as the foetus is small and premature, an easy quick delivery is to be expected should the tone of the uterine musculature be restored. Again, the facts that all the blood has remained in the uterus and that the patient's condition is extremely poor, at any rate to begin with, make more active steps undesirable until she has shown considerable

response to the treatment of her shock. When there is evidence of a definite improvement in both the general condition of the patient and in the local condition of the uterus, which in addition to losing its wooden hardness begins to regain its tone and produce vaginal bleeding, then, and then only, should the membranes be ruptured and as much liquor amnii as possible be allowed to escape. If this is done too early the patient's shock may be aggravated, for it is probable that the uterus will be unable to contract and any relief of tension within the uterus will allow further bleeding to occur. The vagina should not be plugged; the procedure involves a considerable amount of discomfort and disturbance to a patient who is just recovering from an extreme degree of shock. A very considerable improvement in the patient's general condition nearly always occurs if the initial treatment for the shock is carried out, and this improvement may be expected with confidence to be apparent within 3 to 6 hours. If, in spite of the above measures, no improvement occurs, the pain increases, and the girth measurement becomes greater, the outlook is extremely grave. If any operation be performed under these conditions the patient will probably die. Cæsarean section or Cæsarean hysterectomy might appear to have a place in the treatment of this extremely serious complication of pregnancy. If the patient's condition improves sufficiently to suggest that one or other of these operations might be performed with reasonable safety, then experience has shown that the contractile power of the uterus may be expected to return concurrently with the general improvement. In a multiparous woman a comparatively easy labour may be expected if the tone of the uterus is restored, and a major abdominal operation is clearly contra-indicated on this account, although Cæsarean section or Cæsarean hysterectomy may occasionally be indicated in the case of a concealed accidental hæmorrhage in a primigravida.

The patient must be transferred to hospital. If possible blood transfusion and treatment for shock are started before the patient is moved but it is unwise to await recovery. Although cases of concealed accidental hæmorrhage are all severe, they are not of equal severity. In most severe cases the uterus is of the Couvelaire type - atonic, purple in colour with the muscle fibres separated by blood and enormously distended. In such a case the fear is that rupture of the membranes will result in further and fatal bleeding into the emptying uterus which fails to contract. Cæsarean hysterectomy has been suggested for such cases since the uterus would continue to bleed after Cæsarean section. This may occasionally be necessary, but this necessity must be very rare. Most cases of concealed accidental hæmorrhage respond rapidly and satisfactorily to artificial rupture of

the membranes. This would be dangerous in the Couvelaire uterus, as seen at post-mortem, but the atonic Couvelaire uterus is probably the result of delaying artificial rupture of the membranes.

Before rupturing the membranes the patient's blood should be grouped, cross-matched and a blood-transfusion given; this should continue until well after the third stage of labour is over.

A low hæmoglobin during pregnancy is probably an important factor in the production of concealed accidental hæmorrhage and in making the prognosis worse. The possibility of hypofibrinogenæmia as a cause or result of concealed accidental hæmorrhage should be borne in mind. It should be suspected in any case of delayed or absent clotting. It is treated by fibrinogen replacement with blood-transfusion. Plasma is also useful in triple or quadruple strength.

The application of the operations of Cæsarean section and Cæsarean hysterectomy to cases of concealed hæmorrhage may be summed up as follows. Their performance should never be considered immediately after the occurrence of a hæmorrhage. If the patient fails to respond to efficient treatment of her shock, a major operation will probably prove fatal. In the event of a considerable degree of recovery taking place, laparotomy may well be advisable should the patient be a primigravida, but otherwise, in the knowledge that there has been a concurrent improvement in the tonicity of uterine musculature, the onset of labour should be awaited, or encouraged by the gentlest of means.

TREATMENT AFTER THE LABOUR IS OVER

The fact that the patient has been delivered after accidental hæmorrhage and that there is no great amount of postpartum hæmorrhage does not necessarily mean that she will do well. The bleeding must be stopped by the injection of ergometrine, and if necessary by bimanual compression of the uterus. In the absence of efficient treatment some of these patients die a few hours after delivery, from heart failure. Such patients should not be left until recovery from shock is complete, as will be indicated by the general condition, the pulse-rate and blood-pressure. An amount of post-partum hæmorrhage which would be trifling in the case of a robust woman may be of grave consequence in the case of a patient who has had severe antepartum hæmorrhage.

It is important to continue with blood-transfusion until the patient's condition is restored to normal or until the total blood loss has been made good. Bleeding in the third stage must be controlled by ergometrine intravenously during delivery and intramuscularly after.

RENAL CORTICAL NECROSIS AND LOWER NEPHRON NECROSIS

A rare but serious complication of accidental hæmorrhage, particularly of the concealed variety, is anuria. (Similar anuria may also occur as a very rare complication of eclampsia, abortion, or traumatic delivery and postpartum hæmorrhage. Indeed, anuria of this type is not confined to pregnant women ; rare cases have occurred in men and women who are not pregnant, after acute infection, exposure to various toxins, and traumatic shock.)

PATHOLOGY

In fatal cases one of two pathological conditions is found, either renal cortical necrosis or lower nephron necrosis. In *renal cortical necrosis* both kidneys show uniform symmetrical necrosis of almost the entire cortex ; only a thin layer under the capsule survives. The zone of necrosis involves nearly all the glomeruli and a large part of the tubular structure. In *lower nephron necrosis* the kidneys may appear normal to the naked eye, but microscopical examination reveals widespread necrosis and degeneration of the second convoluted tubules and collecting tubules. The glomeruli are not involved.

The mode of production of these two pathological conditions has been much disputed, and it is still uncertain whether they are not different degrees of one pathological change. Renal cortical necrosis is due to ischæmia ; the blood-flow through the cortex ceases. Trueta has brought evidence to show that there is an arterial shunt in the kidney which regulates the blood-flow through the cortex. When the shunt is closed the blood flows through the intralobular vessels to supply all the cortex except a thin lamina which gains its blood-supply from the capsule. When the shunt is open the blood returns to the veins by an alternative pathway which diverts it from the cortex. It is suggested that this shunt is brought into operation in cases of concealed accidental hæmorrhage by toxic substances which pass into the blood-stream, and perhaps also by nervous stimuli from the uterus along sympathetic pathways. Although the details of this theory are not universally accepted, it is at least certain that cortical necrosis is due to ischæmia. The changes are irreversible and inevitably fatal.

The cause of the changes of lower nephron necrosis is less certain. The changes have been attributed to the direct action of a toxin, or alternatively to ischæmia. It is difficult to explain the escape of the glomeruli and the selective effect on the second convoluted tubules

on either hypothesis. It is believed that regeneration of the damaged tubules can occur, and that the cases of obstetric anuria which recover are of this nature.

CLINICAL FEATURES

The initial clinical features of anuria due to cortical necrosis and lower nephron necrosis are identical. After recovery from shock, or after delivery, the first danger sign is the passage of a few millilitres of blood-stained urine. Complete, or nearly complete, anuria follows. The patient remains well for several days, during which time the blood-urea rises progressively. In fatal cases, after about 10 days, drowsiness and twitching movements appear, and death quickly follows the appearance of these signs. In other cases, spontaneous diuresis occurs after about a week, and rapid and apparently complete recovery occurs. It is believed that the cases which recover are due to lower nephron necrosis.

TREATMENT

Since there are no means of distinguishing the fatal cases of cortical necrosis from the cases of lower nephron necrosis in which recovery may occur, the only possible course is to treat all cases alike, and hope that spontaneous diuresis will occur. Many patients have been killed by injudicious treatment, particularly by giving large volumes of fluid intravenously. Diuretics are useless and harmful, and such surgical procedures as decapsulation of the kidneys or splanchnic block probably only add further pain and disturbance to the patient's illness. Although some cases treated surgically have recovered, they might well have done so in any event, and equally frequent and dramatic recoveries follow the simple treatment now to be described.

In anuric patients the only loss of water which is taking place is in the breath, sweat and fæces, and this is less than 1 litre per diem. Unless there is additional loss by vomiting the total fluid intake should never exceed this. Disturbance of electrolyte balance also occurs, but in the absence of the renal mechanism it is highly dangerous to give electrolytes which can so easily be given to excess. The temporary disturbance of balance will neither interfere with spontaneous diuresis, nor will it be of a degree to kill the patient before spontaneous diuresis occurs.

Since breakdown of protein of food or of the tissues may liberate potassium ions, and possibly other toxic substances, protein is excluded from the diet, and a large amount of carbohydrate is given to reduce the breakdown of tissue protein. The diet is nauseous, and for that reason is given by gastric tube. Bull, Joeekes and Lowe summarize

the treatment thus:—"On admission of the patient to hospital a stomach-tube is passed through the nose. Through this tube the following mixture is dripped at a steady rate through the 24 hours: glucose 400 g., peanut oil 100 g., acacia q.s. to emulsify . . . water to 1 litre. All vomit is collected, filtered through lint and returned to the stomach in the same way. This ensures that the fluid intake is accurate, that there is no loss of food by vomiting, and that no loss of electrolytes occurs through vomiting. . . . When diuresis starts urinary losses of the various electrolytes must be made good quantitatively, and to the basic intake of 1 litre of water, fluid is added daily in a volume equal to the urine passed in the preceding 24 hours. It is desirable that the drip feeding should be discontinued and superseded by a low protein diet when the urine output exceeds 1 litre a day."

Bull's regime is being replaced by intravenous glucose *via* a catheter introduced through the femoral vein and pushed up to the inferior vena cava.

Another method is to restrict the fluid intake to 400 ml. a day. Calories are limited to the amount contained in 100 to 200 g. of glucose. The glucose water and a generous supply of added vitamins are given by mouth.

In cases showing clinical deterioration dialysis by means of the artificial kidney is used.

It is suggested that norethandrolone—a synthetic anabolic steroid, which reduces the metabolic response may largely eliminate the need for dialysis in acute reversible renal failure occurring as a complication of pregnancy.

UNAVOIDABLE HÆMORRHAGE (PLACENTA PRÆVIA)

DEFINITION

A placenta is prævia when it is wholly or partly attached to the lower uterine segment.

VARIETIES

1. **Complete or Central** when the placenta covers the internal os uteri (Fig. 180). In this case the finger passed through the cervical canal cannot reach the membranes.

2. **Incomplete** when the placenta does not cover the internal os uteri. There are two varieties of incomplete placenta prævia.

(a) So-called marginal, when the placenta comes down to the internal os and its edge where it crosses the os can be reached by the finger (Fig. 181).

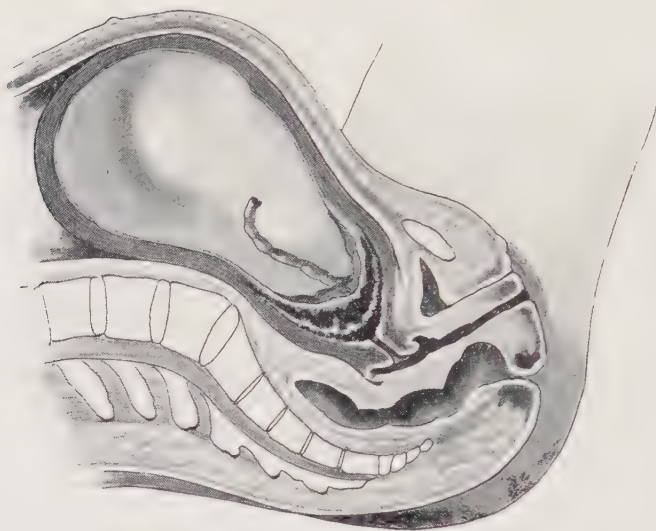


FIG. 180.—COMPLETE PLACENTA PRÆVIA.

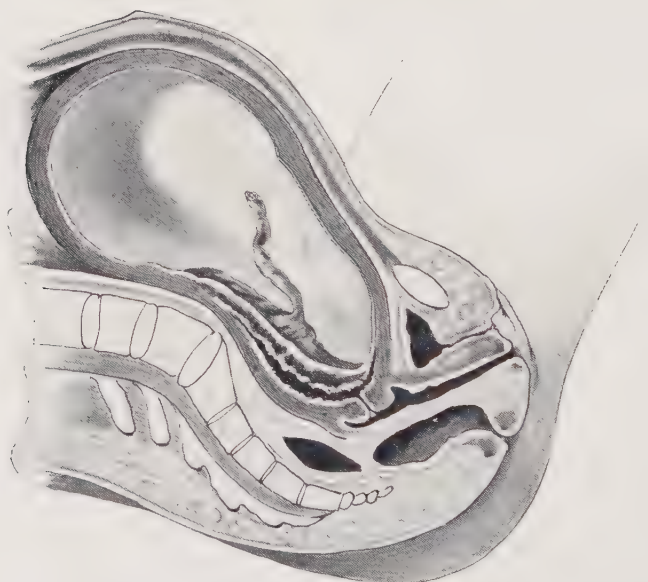


FIG. 181.—MARGINAL PLACENTA PRÆVIA.

The placenta is on the lower uterine segment and extends over the internal os, but the membranes at the lower edge of the placenta are within reach of the examining finger.

- (b) So-called lateral, when the placenta does not reach as low as the internal os, but is situated partly on the lower uterine segment, (Fig. 182).

There is a tendency to discontinue the use of the terms central, lateral and marginal, as confusion is caused by the terms "lateral" and "marginal" not being used consistently by medical writers.

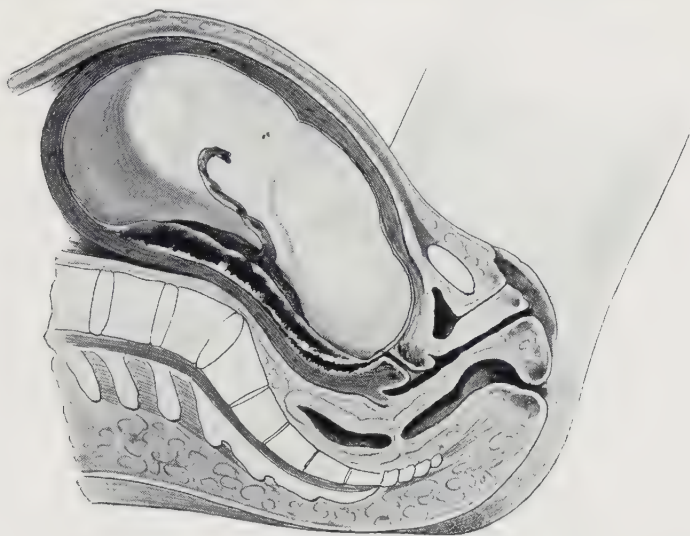


FIG. 182.—LATERAL PLACENTA PRÆVIA.

The placenta is on the lower uterine segment, but does not reach the undilated internal os.

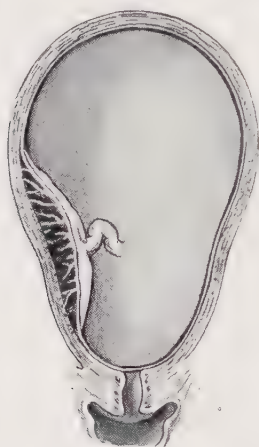
A classification has been suggested to replace the old terms and is illustrated (Fig. 183).

- Type I. The placenta lies in the lower segment but its lower edge does not reach the internal os.
- Type II. The lower edge of the placenta reaches the internal os but does not cross it.
- Type III. The edge of the placenta crosses the internal os but the examining finger can feel the membranes close to the os.
- Type IV. The placenta completely covers the internal os and the edge of the placenta and the membranes are too far away to be felt by the examining finger.

The findings in any given case will vary with the degree of dilatation of the cervix, and a case which may appear complete when the internal os will only admit the finger tip may later be found to be incomplete when further dilatation allows the edge of the placenta to be felt.

Placenta prævia occurs about once in 500 labours, and is most common in women who have had a number of children.

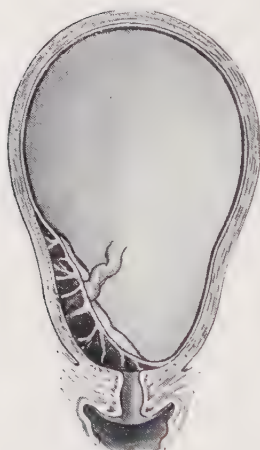
Pathological Anatomy.—The placenta usually covers a larger area than normal, is thin and irregular in shape; it is frequently degenerated, and contains infarcts which may undergo calcification.



Type I.



Type II.



Type III.



Type IV.

FIG. 183.

These changes are explained by the comparatively poor blood-supply which the placenta obtains from the non-vascular lower segment. The cord frequently has a marginal insertion. The lower segment of the uterus and the cervix are softer and more vascular than usual, in consequence they tear more readily.

Cause of the Hæmorrhage.—The hæmorrhage comes from the maternal blood-vessels in the lower segment, which are opened up by the separation of the placenta as the lower segment dilates. Except in cases in which the placenta is torn during manipulations, there is no hæmorrhage from the foetal circulation.

SYMPTOMS AND COURSE OF LABOUR

At full time, or more frequently during the last 3 months of pregnancy, the patient notices slight hæmorrhages from the vagina. They come on without apparent cause, perhaps in the middle of the night. but, as in accidental hæmorrhage, they may follow hard exercise or trauma. These slight hæmorrhages may be followed by a continuous brown discharge. Though repeated slight hæmorrhages commonly occur, the first bleeding may be a severe one. Pain is not experienced.

Labour, especially in the first stage, is tedious because the uterus acts feebly. The bag of waters is not present in types II, III and IV, because the placenta forms part of the lower pole of the ovum, thus diminishing its dilating effect. After rupture of the membranes the effect of the presenting part in exciting uterine contractions is diminished by the intervention of the placenta, and the thickened and more vascular lower uterine segment dilates less easily.

The third stage is liable to be complicated by immediate and recurrent postpartum hæmorrhage because the area of placental attachment is larger than normal and because it covers a variable amount of the lower uterine segment which does not undergo efficient retraction. In addition, bleeding from any lacerations of the cervix may be expected to be more severe owing to the associated increased blood-supply to the lower segment.

DIAGNOSIS

A history of repeated losses of blood, small in amount at first but usually increasing, is strongly suggestive of placenta prævia.

On abdominal examination, an indication of the nature of the case may be obtained from finding the child lying obliquely or its head above the brim of the pelvis, or presenting by the breech, because the placenta is filling the lower segment. Otherwise the uterus is normal on palpation. The urine will probably not contain albumin.

On vaginal examination, the soft spongy mass formed by the placenta may be palpable through one of the fornices, or the head, if presenting, may be felt plainly through one fornix and indistinctly through the other. *A certain diagnosis can only be made by feeling the placenta with a finger passed through the internal os. This*

may be followed by furious bleeding, and it should only be done in an operating theatre when the patient can be treated immediately by whatever method is thought advisable.

Determination of the Situation of the Placenta by Radiography.

The diagnosis of the situation of the placenta by radiography is often attempted in patients who have had antepartum hæmorrhage. The diagnosis of a placenta prævia by X-rays cannot be regarded as infallible, and it cannot yet be said that a placenta prævia can be safely excluded by radiological methods.

The degree of success attained depends on the keenness and interest shown by the radiologist, radiographer and obstetrician in the unit concerned. In certain centres excellent results are obtained by soft tissue X-rays, which are variously used, either, to show the placenta directly or the space between the uterine wall and the fœtus or the persistence of a space between the presenting part and the symphysis pubis or the sacral promontory. It is likely that increasingly good results will be obtained as these methods are more commonly used. This procedure is worth using if the exposures are limited to one or two.

PROGNOSIS

Maternal.—The prognosis will largely depend on the amount of hæmorrhage which is always greater with a complete than with an incomplete placenta prævia. The earlier the diagnosis is made the sooner can the patient be put into surroundings in which efficient surgical treatment can be adopted. Early diagnosis is most important as many of the fatal cases have bled severely, or have already been infected, before any skilled treatment can be carried out. The prognosis is much more serious in a primigravida with an unyielding cervix than in a multipara. When the uterus is contracting, treatment is urgently called for as the bleeding will continue and probably increase in amount. The prognosis is much more serious if the patient has to be dealt with in her own home and not in an institution. Series of cases from institutions show a mortality of under 1 per cent.

The causes of the maternal death in placenta prævia are sepsis, hæmorrhage and shock. Sepsis is common, because the resistance of the patient is lowered by loss of blood, and because of the necessary manipulations. Hæmorrhage may be both antepartum and postpartum. Shock is due to rapid delivery.

Postpartum hæmorrhage may occur from uterine inertia, from the large size of the placental site, from the placenta being situated low down where the retractile power of the uterus is weaker, and from

lacerations of the vascular cervix. Recurrent postpartum hæmorrhage may occur. A small postpartum hæmorrhage may be fatal to an exsanguinated patient.



FIG. 184.—PLACENTA PRÆVIA. THE BLADDER CONTAINS 20 C.C. OF OPAQUE FLUID. THE GREATER PART OF THE PLACENTA WAS ON THE LEFT SIDE.

Fœtal.—Unless Cæsarean section is performed or unless the placenta prævia is of the lateral type, the outlook for the child is bad. The causes of fœtal death are, asphyxia due to lack of oxygen from

pressure upon or separation of the placenta, pressure on the umbilical cord, hæmorrhage from the separated placenta, and prematurity. Severe maternal shock and anæmia also cause foetal anoxia.

TREATMENT

If placenta prævia is diagnosed or even suspected, the patient should be moved as soon as possible to an institution unless the loss has been severe. If the patient is bleeding severely in her own home when first seen she should be given morphia (0·06 g.) gr. $\frac{1}{4}$ and the doctor should send for the obstetric flying squad, the members of which will be able to treat the patient for her blood loss. Only in women who are in labour will any obstetric interference be necessary before the patient is in hospital. *It is most important that no vaginal examinations should be made or plugging introduced into the vagina before transfer to hospital, as such an examination may cause further serious hæmorrhage.* The patient's condition may allow her to be moved immediately by ambulance or in a few hours after her condition has improved. On admission to an institution the patient should have her blood grouped. Unless the hæmorrhage is severe there is no necessity for immediate active treatment. The best method of treatment can be selected only after consideration of the age, parity and previous obstetric history of the patient; the maturity and presentation of the foetus: the amount of hæmorrhage and the general condition of the patient; whether labour has begun, the degree of dilatation of the cervix, and the type of placenta prævia. As the latter two observations depend on vaginal examination, a decision regarding the best method of treatment must be deferred until the patient is in the operating theatre.

In all cases with severe bleeding immediate active treatment is required, and delay is perilous. But the chief cause of foetal mortality in cases of placenta prævia is prematurity, and if the bleeding is only slight and the foetus is some weeks premature then the risk of keeping the patient in bed while the foetus grows is justifiable, provided she is in a hospital where treatment by transfusion and operation is immediately available should severe bleeding occur. This expectant attitude has greatly reduced the foetal mortality in recent years without increasing the maternal mortality.

If (1) severe loss occurs at any time, or (2) in a case with slight bleeding which is near term and in which the history and abdominal signs are suggestive of placenta prævia, active investigation and treatment are required. If bleeding has been severe transfusion is immediately begun; if it has not been severe suitable blood is obtained and kept available. As soon as any blood loss has been made good and

the patient's general condition has improved, she is anæsthetized in the operating theatre, with the instruments ready for Cæsarean section. A finger is gently passed through the cervix to determine whether the placenta can be felt. It has been suggested that this examination is unnecessary if the history and the abdominal signs point to the presence of a placenta prævia, as there is some risk of increasing the bleeding by disturbing the placenta. Provided that the examination is carried out gently, in the operating theatre with facilities for immediate treatment, the risk is small; and if this examination is omitted some patients will be unnecessarily submitted to Cæsarean section.

If a central (Type III or IV) placenta prævia is found Cæsarean section is immediately performed. Even if the foetus is dead or premature this is justifiable, as the purpose of the operation is to stop the bleeding by emptying the uterus and allowing it to retract. The operation should never be performed while the patient is severely shocked from exsanguination; shock must be treated first.

If a marginal (Type II) placenta prævia is found Cæsarean section is the best course in primigravidæ and in most multiparæ. It is not indicated in cases in which the cervix is more than half dilated and the loss of blood is slight.

A lateral (Type I) placenta prævia cannot always be felt on vaginal examination. In cases of vertex presentation, if the placenta cannot be felt, or can be felt at a little distance from the os, the membranes should be ruptured and an abdominal binder applied. This allows the presenting part to descend and compress the placenta, thus controlling the bleeding.

If Cæsarean section is to be performed and the placenta is lying anteriorly, the classical operation is preferred by some obstetricians.

Other Methods of Treatment.—In this country almost all cases are within reach of hospital facilities, so that other forms of treatment are very seldom employed, though they may still be mentioned for the benefit of the occasional patient for whom proper obstetric care is unobtainable or for whom Cæsarean section cannot be performed. These older methods are less effective in controlling hæmorrhage, are more often followed by infection, and give worse foetal results than the methods already described.

The principle involved in the control of bleeding in these methods is pressure on the placental site by the presenting part. The simplest means is artificial rupture of the membranes, which, combined with the application of an abdominal binder allows the head to descend. This operation is often successful with a lateral (Type I) placenta prævia in multiparæ.

The application of Willet's scalp forceps to the foetal scalp with traction by a weight of about one pound may be used, if the bleeding is not controlled by artificial rupture of the membranes. This method entails the minimal amount of interference and therefore less risk of sepsis.

If facilities for Cæsarean section are not available in cases in which the bleeding is severe and the placenta either completely or partially covers the internal os (Types III and IV), more active treatment is indicated. This will vary accordingly to the size of the os.

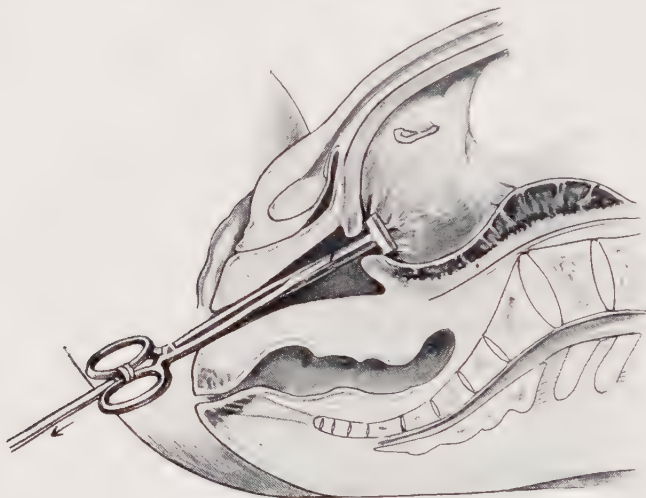


FIG. 185.—WILLETT'S FORCEPS MAKING TRACTION ON THE HEAD IN A CASE OF PLACENTA PRÆVIA. TYPE II.

Weight traction of 1 lb. should be applied to the forceps.

Plugging the vagina is useless. It does not stop bleeding from placenta prævia and may deceive the attendant by hiding some of the blood loss. The plug is painful, difficult to insert, increases the danger of sepsis and sooner or later it has to be removed. If the patient is in labour with a cervix half-dilated and the breech presenting it may be good practice to pull down a leg to plug the lower segment while the uterus contracts and dilates the cervix. This is more likely to be the right treatment in domiciliary than in hospital practice, as it involves an increase in the foetal mortality.

Whatever treatment is adopted blood-transfusion should be freely employed, for although the patient may recover from the initial hæmorrhage, the possibility that further bleeding may occur in the third stage must be anticipated by replacing blood-loss in good time.

CHAPTER XXXVI

POSTPARTUM HÆMORRHAGE

DEFINITION

POSTPARTUM hæmorrhage is excessive bleeding which takes place from the genital tract after the birth of the child. A loss in excess of 600 c.c. (20 ounces) is the standard adopted. Postpartum hæmorrhage is classified as Primary, Reactionary and Secondary.

Two types of primary postpartum hæmorrhage are recognized :—

1. Hæmorrhage from the placental site (atonic hæmorrhage).
2. Hæmorrhage from lacerations of the genital tract (traumatic hæmorrhage).

Of these the former is the more commonly met with and the more serious.

HÆMORRHAGE FROM THE PLACENTAL SITE

PATHOLOGY

It is impossible for the placenta to separate without exposing the open mouths of the maternal sinuses in the uterus and thus some blood must escape during the third stage of labour. In this way a loss of 240 c.c. (8 ounces) usually occurs in a normal labour. Although it is customary to regard a loss of 0.6 litre (1 pint) and over as pathological, any loss which appears excessive to the observer must be treated as postpartum hæmorrhage.

The mechanism by which the blood-loss is normally controlled is by the retraction of the uterine muscle fibres. These muscle fibres surrounding the vessels in the wall of the uterus compress their lumina by retraction and thus the hæmorrhage is checked. Clotting of blood by itself will not suffice, as is proved by the occurrence of reactionary postpartum hæmorrhage when retraction is not maintained.

CAUSES

1. *Weak uterine contraction and retraction.*—Weak contraction of the uterus in the third stage of labour may fail to separate the placenta completely, so that it remains in the upper segment and prevents effective retraction of the placental site. In other cases, even though

the placenta has been completely separated and has been expelled, severe hæmorrhage occurs if the uterus fails to maintain its retraction.

If the uterus is not completely empty retraction will be ineffective. Although it is true that a very strong contraction, for example after the injection of ergometrine, may temporarily control bleeding even if the placenta is still in the uterus, in cases in which the contractions are less strong the presence of the placenta or a large mass of blood-clot in the uterus will interfere with retraction. Uterine action is also less efficient if the bladder is not empty.

Weak uterine action may occur in cases in which:—

- (a) There has been a long labour, especially in cases due to weak or inco-ordinate uterine action, but also in cases of long labour due to mechanical difficulty if uterine exhaustion occurs.
- (b) Prolonged or deep anæsthesia has been administered.
- (c) The uterus has been overdistended by hydramnios or multiple pregnancy. In twin pregnancy the placental site is also larger than normal.
- (d) The patient is a multipara with an atonic uterus.
- (e) The uterus is atonic because of concealed accidental hæmorrhage.

2. *Mismanagement of the third stage of labour.* After a normal delivery, if ergometrine has not been injected at the end of the second stage, the uterus remains at rest for a few minutes. The placenta is still completely attached, and no bleeding occurs. But if the uterus is squeezed during this interval the placenta may be partly separated, and bleeding begins and must inevitably continue until uterine contractions complete the separation and allow proper retraction to follow. Such injudicious attempts to expel the placenta before normal separation has occurred, and in the absence of uterine contractions, are a common cause of postpartum hæmorrhage.

3. *Placental abnormalities.*—In rare instances the placenta may be abnormally adherent, sometimes because the chorionic villi have penetrated more deeply than usual and entered the muscle wall (placenta accreta). If such a placenta is only partly separated it will remain in the upper segment and interfere with retraction.

In cases of placenta prævia the placenta may have a wider area of attachment than normal, and the lower segment may fail to retract strongly enough to control the bleeding effectively.

4. *Hypofibrinogenæmia* (see Chap. XXIV) is an occasional cause of severe postpartum hæmorrhage. The fibrinogen available in the blood is so deficient that clotting is delayed or does not occur. It is especially associated with concealed accidental hæmorrhage, but it also occurs in cases of intra-uterine death of the fœtus and in amniotic embolism.

In accidental hæmorrhage the liberation of thromboplastin from placental tissue into the blood-stream uses up the fibrinogen. In amniotic embolism the fibrinogen may be rapidly used up by a fibrinolytic in the amniotic fluid.

DIAGNOSIS

In the great majority of cases in which blood is issuing from the vulva, the question to be decided is whether the blood is coming from the placental site or from lacerations, but in rare instances severe bleeding may take place into the cavity of an atonic uterus without much appearing externally. If the third stage is correctly conducted, with the left hand on the abdomen, softening and enlargement of the uterus will draw attention to the blood inside the uterus.

SYMPTOMS AND SIGNS

The symptoms and signs are those of hæmorrhage. The observation that the patient is bleeding excessively is enough. The blood-pressure is low. In very severe cases, pallor, a rapid pulse rate and air hunger occur.

PROGNOSIS

The immediate prognosis depends on the rate at which the blood is lost, the amount of the blood-loss and the condition of the patient prior to the loss.

Owing to the increase in the total quantity of blood during pregnancy, a parturient patient stands hæmorrhage comparatively well, and may recover when some pints have been lost, provided the loss is not too rapid. On the other hand, a patient who is already exsanguinated by an antepartum hæmorrhage will rapidly die if even a small quantity of blood is lost after delivery; and, in a similar way, a comparatively insignificant secondary postpartum hæmorrhage may turn the scale against a patient who has lost freely at the time of delivery.

Postpartum necrosis of the anterior lobe of the pituitary gland is a rare sequel in cases of severe hæmorrhage in which the blood-pressure has remained at a low level for some time (see p. 483).

TREATMENT

Prophylactic Treatment.—The prophylactic treatment of postpartum hæmorrhage is a matter of great importance. Anæmia must be treated during pregnancy. Some patients give a history of

postpartum hæmorrhage occurring in one or two previous labours. Such cases should be admitted to hospital for delivery. Although investigation of the bleeding time and clotting time of the blood may be a wise precaution, these tests usually reveal nothing abnormal. In cases of concealed accidental hæmorrhage or intra-uterine foetal death, fibrinogen or concentrated plasma should be available.

Many cases of postpartum hæmorrhage can be avoided by the proper conduct of labour. In the first stage of labour it is important in cases of uterine inertia to give the patient sleep, to encourage the uterus to contract properly. In the second stage, immediate instrumental assistance should be given if the uterine contractions are becoming less efficient. The proper conduct of the third stage is the most important single item in the prevention of this complication, and the correct use of ergometrine will greatly reduce the amount of blood lost (see p. 150).

The conduct of the third stage of labour has been very much altered by the use of ergometrine maleate either with the delivery of the head or the anterior shoulder. The ergometrine may be given by intravenous injection 0.25 to 0.5 mg., or by intramuscular injection of 0.5 mg. or intramuscular injection with hyaluronidase 0.5 mg. When given intravenously, the uterus contracts within one minute; intramuscularly 5 to 7 minutes, intramuscularly with hyaluronidase in 3 to 4 minutes.

The best method is to give intravenous ergometrine with the birth of the anterior shoulder. This usually results in the delivery of the placenta in 5 minutes with very slight blood-loss. If the injection is given before the delivery of the anterior shoulder there is the danger of the uterus acting too powerfully on the child.

In domiciliary practice a midwife working alone may find it impossible to give her patient an intravenous injection and for such cases an intramuscular injection with hyalase has the advantage of saving two minutes which may be of vital importance.

Ergometrine should be ready in a syringe before every baby is born and should be given intramuscularly if it has not been given intravenously or in cases in which hæmorrhage continues after the delivery of the placenta. If intramuscular ergometrine is given after the baby is delivered there is a danger of the placenta being retained by a contraction ring or tonic uterine contraction.

Ergometrine should not be used in twins until the delivery of the second baby, nor in cases of very powerful uterine action.

Curative Treatment.—The hæmorrhage must be arrested. The medical practitioner may occasionally be called to an emergency case in which such severe bleeding has already taken place that the patient

is exsanguinated when she is first seen. In such cases the services of a flying squad should be demanded.

Bleeding ceases when the uterus strongly contracts, and is empty. The best way of achieving this aim will depend on the following factors :—

1. Whether the placenta has been delivered or not, and if not, whether it has already separated.

2. Whether the patient has already been given an injection of ergometrine.

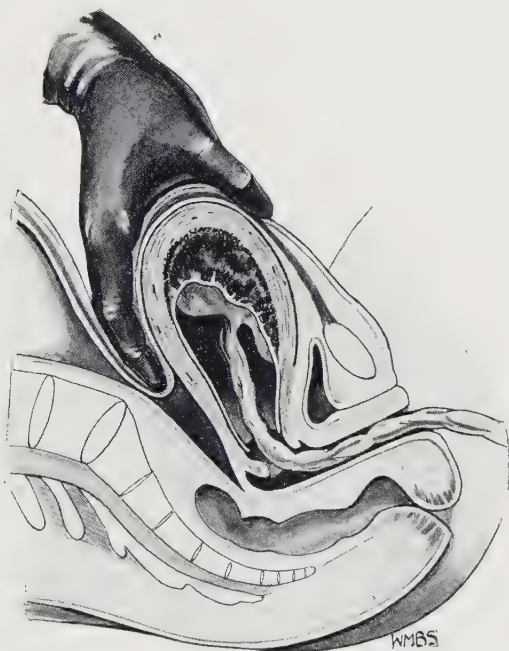


FIG. 186.—TO SHOW CRÉDÉ'S METHOD OF EXPRESSING THE PLACENTA BY SQUEEZING THE UTERUS.

3. If the patient is delivered in her home the attendant must stop the bleeding by every means at his command. In England and Wales and most parts of Scotland there are few places without a flying squad being available within 30 minutes. The flying squad is composed of an obstetrician, anæsthetist and nurse equipped with all that is necessary for blood-transfusion, resuscitation and such obstetric operations as are immediately necessary. When a patient has postpartum hæmorrhage which the midwife or doctor is not able to control, the flying squad should be sent for. The patient will receive immediate attention at home. A patient should not be moved to hospital until she has been given blood ;

the placenta has been removed and the bleeding has ceased. If the patient is moved to hospital with the partially separated placenta in the uterus she may die on the journey from hæmorrhage.

(a) *Bleeding before the birth of the placenta.*—If the placenta is still undelivered the patient is turned upon her back, the left hand is placed on the abdomen, the uterus is gently rubbed until it becomes firm, and then the fundus is palpated to determine whether the placenta has separated or not (see p. 148 for the signs of separation). If the placenta has separated it can easily be expelled by backward and downward pressure on the contracted fundus. Although it is true that traction on the umbilical cord would do no harm if the placenta has separated and the uterus is contracting well, this would be highly dangerous in the absence of these conditions, when inversion of the uterus might be the result. Since there is often uncertainty about the separation, and it is easy for the inexperienced to be mistaken on this point, traction on the umbilical cord is not recommended.

If the placenta has not separated the management of the case is far more difficult. Squeezing the uterus to separate the placenta from its attachment in the upper segment is spoken of as Crédé's expression. It is carried out by placing the fingers on the posterior wall and the thumb over the fundus on the anterior wall, as shown in Fig. 186. After rubbing up a contraction the uterus is squeezed firmly; it is important to squeeze the uterus and not to push it into the pelvis. It is usual for right-handed people to do this with the left hand, keeping the right hand sterile and ready to carry out any further manipulation. The uterus must not be squeezed or pressed upon while it is relaxed for fear of inverting it.

Crédé's method was introduced because inversion was so often caused by cord traction used on a soft uterus, and because of the grave dangers—in the past—of manual removal of the placenta.

Crédé's method should only be employed if the uterus can first be made to contract. If it is used on a soft uterus inversion may occur. The method has become unpopular because of its limited use, because manual removal of the placenta is now relatively safe and easy, and because Crédé's method is often used wrongly, repeatedly and forcibly and causes pain, shock and a waste of valuable time.

Manual removal of the placenta is performed by passing the right hand into the uterus and following the cord up to the placenta. The left hand is kept on the abdominal wall, and serves as a guard against the risk of perforating the uterus with the internal hand. The edge of the placenta is identified, and then the placenta is gradually separated with the fingers. Only when it is completely free should any attempt be made to withdraw it. After separation of the placenta its site of

attachment will remain as a raised and rough area, and the inexperienced operator must not mistake this for a piece of retained placental tissue.

In the past manual removal of the placenta performed on a shocked patient, with no anæsthesia or inadequate anæsthesia was a very frightening and hazardous operation and accompanied by grave risks of infection. Now the operation is usually done with adequate anæsthesia, on a uterus contracting under the influence of ergometrine, and the fear

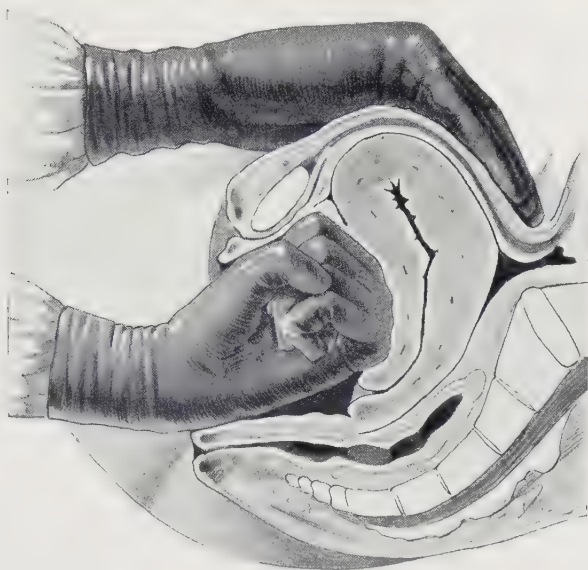


FIG. 187.—BIMANUAL COMPRESSION OF THE UTERUS.

In the illustration the operator is standing between the patient's legs. For this the patient must be placed across the bed with her buttocks resting on the edge. Bimanual compression can be performed equally well with the patient lying on her back in the bed in the ordinary position. In these circumstances it is obviously easier for the operator to place his right hand in the vagina and his left on the patient's abdomen.

of subsequent infection—while not removed—is minimised by blood-transfusion and antibiotics. Therefore, it is now common practice to have recourse to manual removal of the placenta at once if cord traction fails in a case of postpartum hæmorrhage. When this is done it is often found that the placenta is partially adherent near a cornu, or retained by a contraction ring.

(b) *Bleeding after the birth of the placenta.*—If bleeding takes place after the placenta has been delivered, and the patient has not already had an injection of ergometrine this should be at once given intravenously (0.5 mg.). The uterus should be rubbed gently to stimulate

a contraction, and any contained blood-clot expelled. If the bleeding continues, bimanual compression of the uterus should be performed immediately (Fig. 187). This is carried out as follows: one hand is inserted into the vagina, then closed so as to make a fist with the back of the hand directed posteriorly and the knuckles in the anterior fornix; the other hand is placed on the abdomen resting on the posterior surface of the uterus and the anteverted uterus is pressed down on to the fist in the vagina. In this way the posterior wall is pressed against the anterior, and the hæmorrhage checked. *In cases of severe bleeding it should be performed as soon as the placenta is removed, without wasting time on less effective methods of treatment and while waiting for the ergometrine to act.* Compression properly carried out is absolutely effective. It should be kept up until the uterus retracts; however, it is tiring to perform, and after a quarter to half an hour, an assistant may be required to replace the obstetrician in order to maintain continued firm pressure. It is also possible in patients whose abdominal wall is lax to compress the uterus between two hands both applied through the abdominal wall.

Occasionally after bimanual compression has been performed and after ergometrine has been injected, the uterus appears to be unable to maintain its tone with the result that hæmorrhage recurs. In this event, the ergometrine must be repeated and may be injected into the uterus through the abdominal wall.

Treatment of the Collapse caused by Hæmorrhage.—If the patient's pallor, rapid pulse-rate and low blood-pressure show that the bleeding has been sufficient to cause circulatory collapse blood-transfusion is urgently required. If the patient's blood-group is not already known there will not be time to determine her rhesus group, and in a real emergency rhesus negative blood should be used. Most obstetric hospitals are able to obtain Group O rhesus negative blood in an emergency, but in every case a direct agglutination test of the donor's corpuscles and the patient's serum is essential. In domiciliary practice a flying squad should be summoned. If blood is not immediately available one of the modern plasma substitutes should be given, or failing that, intravenous normal saline (gr. 60 of salt to the pint of sterile water, or 7 gr. to the litre).

Dextran should not be used if hypofibrinogenæmia is suspected. If it is used in other cases blood must first be taken for grouping and cross-matching, as the dextran may interfere with the accuracy of the matching. Dextran may delay coagulation by dilution of the already decreased fibrinogen content and by encouraging the precipitation of fibrinogen as fibrin or by forming a fibrinogen-dextran compound.

Citrated blood only replaces blood-loss not fibrinogen-loss and so is wasted if used alone in cases of hypofibrinogenæmia.

The patient must be kept quiet with her head low, so that the failing circulation supplies the medulla with blood. If she is uncontrollably restless an injection of morphia is given, but this is otherwise undesirable as it will still further depress the shallow respiration. Oxygen can be administered.

Late Postpartum Hæmorrhage.—It occasionally happens that relaxation follows the retraction produced by stimulation of a partly exhausted uterus. The blood may collect inside the uterus. If this should occur the blood must be expelled and the uterus observed carefully. This is done by placing a hand on the fundus and keeping it there for 30 minutes to 1 hour, a precaution which in any case should be observed following any severe postpartum hæmorrhage. Any sign of relaxation can be noticed at once and further loss of blood thus prevented. It is injudicious to leave a patient until her pulse-rate is below 100.

A retained piece of placenta may also cause reactionary or secondary postpartum hæmorrhage, and the placenta should always be examined carefully after delivery to make certain that it is complete. If any part of the placenta is left in the uterus it must be removed manually under anæsthesia.

Secondary Postpartum Hæmorrhage.—This occurs later than 24 hours after the birth of the child and may come on quite late in the puerperium, very commonly about the 10th day. It is usually caused by a retained portion of placenta, or more rarely by fibroids protruding into the uterine cavity. There is, however, another type of secondary postpartum hæmorrhage which occurs in infected cases and is due to the separation of a septic slough. The bleeding may come from the cervix, from a Cæsarean wound, or from the placental site. In these cases there is usually fever, offensive lochia, or other evidence of infection.

Treatment depends upon the cause. When a piece of placenta has been left in the uterus it should be removed by the finger. For the 1st week after delivery it is usually easy to introduce at least two fingers through the cervix, without any instrumental dilatation. In this as in all other intra-uterine operations, counter-pressure must be made on the fundus. A curette should not be used as the uterine wall is soft and can easily be perforated. The appropriate antibiotic is given in infected cases. In this type of case if the bleeding is not controlled with ecbolics the cervix should be inspected.

HÆMORRHAGE FROM LACERATIONS

A torn cervix may cause persistent hæmorrhage, especially in cases of placenta prævia. Lacerations must be suspected as the source of the hæmorrhage if the loss commences immediately the child is born and continues although the uterus is retracted. Although such hæmorrhage is rarely profuse, it tends to continue, as it may come from a branch of the uterine artery and may be enough to endanger the patient's life unless stopped.

The ideal treatment is to tie the bleeding point and suture the tear. To suture a deep cervical tear the patient should be put in the lithotomy position, the perineum retracted, and the cervix pulled down to the vulva with a pair of sponge forceps. The split cervix is then stitched with catgut; the highest stitch is the most important, as it will control the cervical branch of the uterine artery from which the blood is coming. If a needle and catgut are not available at once, the hæmorrhage can be stopped by clamping the highest part of the tear in the cervix with a sponge holder. If instruments are not available, pressure should be made on the bleeding point in the tear by a gauze plug in the vagina.

Hæmorrhage may also be due to tearing of a varicose vein in the labium majus, a laceration near the clitoris, a tear of the vagina or of the perineum. A considerable amount of bleeding may occur from a neglected episiotomy incision.

Bleeding from a varix of the vulva is difficult to control with stitches, as each stitch may wound a fresh vein, and so it may be treated by the application of a sterile pad and firm bandage. Tears near the clitoris should be sewn with catgut. Lacerations of the vagina and perineum should be sutured. Mattress sutures may be necessary for very vascular areas.

POSTPARTUM OR OBSTETRIC SHOCK

CAUSES

Shock has been defined as 'a syndrome resulting from depression of many functions, but in which reduction of the effective circulation volume and blood-pressure are of basic importance' (Wiggers).

Some authorities have implied that obstetric shock differs from shock encountered in surgical work. There is no evidence for this, but, there are some conditions causing shock which are peculiar to obstetrics, such as hypofibrinogenæmia and amniotic embolism.

Most cases of shock in obstetrics are associated with severe hæmorrhage and especially when trauma is added or long and repeated

anæsthetics have been given. Severe anoxia during anæsthesia will increase shock.

It has been suggested that shock may occur if the placenta is long retained in the uterus, even in the absence of hæmorrhage. Shock never occurs in such cases, unless unwise and rough attempts to expel the placenta have been made. Shock may be caused by manual removal of the placenta but when bleeding is occurring the placenta must be removed.

In other cases shock may follow prolonged or difficult labour, forcible dilatation of the cervix, difficult instrumental delivery, internal version, rupture of the uterus, inversion of the uterus, or the use of pitocin. Shock is usually caused by more than one factor, commonly a combination of hæmorrhage, trauma and prolonged anæsthesia but it may be purely neurogenic and due to fright. Hypofibrinogenæmia is only a special case of hæmorrhage causing shock.

Amniotic embolism may cause shock by producing hypofibrinogenæmia or by causing pulmonary œdema.

Very rarely acute adrenal necrosis or hæmorrhage may cause severe shock. Other causes are air embolism, reaction to the transfusion of incompatible blood, and severe claustridial infections.

Treatment.—In the treatment of shock it is essential to restore the circulating blood-volume as quickly as possible with blood. Plasma substitutes should only be used if blood is not available and with the precautions already mentioned. As a temporary measure it is best to use intravenous saline while awaiting the arrival of blood. Cases of hypofibrinogenæmia will need the intravenous administration of fibrinogen or quadruple strength plasma. In adrenal failure cortisone must be used. In cases in which the blood-pressure remains low a 1-noradrenaline drip should be set up. Oxygen and morphia are valuable.

POSTPARTUM PITUITARY NECROSIS

Severe postpartum collapse due to hæmorrhage may be followed by ischæmic necrosis of the anterior lobe of the pituitary gland. Thrombosis occurs in the vessels which supply the anterior lobe, and necrosis of the whole lobe occurs, except for a thin rim of tissue which may survive at the surface of the lobe. Death may occur soon after delivery, but if the patient survives she will show the clinical picture of Simmonds's disease (pituitary cachexia). All the endocrine functions of the anterior lobe of the pituitary gland are disturbed. There will be failure of lactation due to lack of the lactogenic hormone. Because

of lack of thyrotropic hormone the patient becomes lethargic, abnormally sensitive to cold, and usually gains weight. Her basal metabolic rate falls, and her glucose tolerance is increased. Because of lack of corticotrophic hormone she will also have asthenia, a low blood-pressure, and will respond poorly to infection. Lack of gonadotrophic hormones will lead to genital atrophy, with superinvolution of the uterus, amenorrhœa, and atrophy of the breasts.

Less severe cases may only have part of this complex clinical picture, and in very rare instances a further pregnancy has followed, with regeneration of the pituitary gland.

Prompt treatment of collapse due to postpartum hæmorrhage should prevent this disastrous complication. Once the necrosis has occurred substitution therapy may maintain the patient in fair health. For the hypothyroidism thyroxine will be required. For the failure of suprarenal function adrenocorticotrophic hormone, suprarenal cortical hormones, or desoxycortone may be given, but the best use of these substances is still a matter of trial. Large doses of salt may be necessary. There is no useful purpose in giving gonadotrophic hormones, but testosterone has been found to supplement the action of cortical hormones.

CHAPTER XXXVII

DELAYED DELIVERY OF THE PLACENTA AND MEMBRANES

THE classical signs that the placenta has been separated and expelled from the uterus into the vagina are that the uterus rises, becomes smaller, harder, and more mobile, the umbilical cord lengthens, and slight hæmorrhage occurs from the vagina. The vagina has a feeble musculature, and it usually happens that, unless the patient assists by straining, the placenta may remain in the vagina after its extrusion from the uterus.

Retention of the Placenta in the Uterus.—The time taken for the placenta to be separated from its uterine attachment and expelled from the uterus depends on the force of the uterine contractions and on the firmness of the attachment to the uterus. The retention of the placenta in the uterus for over 1 hour is regarded as pathological.

CAUSE

Non-delivery of the placenta may be due to inertia of the uterine muscle, morbid adhesion of the placenta to the uterine wall, a contraction ring in the muscle or to rupture of the uterus.

Inertia of the Uterus.—If the uterus does not retract sufficiently after labour the diminution in size of the placental site will be less than usual, and so the placenta will not become detached so soon as usual. When the uterus has recovered its tone, efficient retraction occurs and the placenta separates. Uterine inertia is sometimes sufficiently marked to cause prolonged delay in the third stage of labour, and at times leads to partial separation of the placenta with hæmorrhage, especially if the delay has led to vigorous and injurious efforts at expression.

Morbid Adhesion of the Placenta.—Normally the placenta separates through the spongy layer of the decidua which is the line of least resistance. In some cases this spongy layer is not formed, and on sections being made of the placental site it is found that the decidua basalis is absent and the villi are in direct contact with the

muscle of the uterus (placenta accreta). Under such conditions there is no preformed line of cleavage, and the placenta does not separate under the stimulus of normal uterine action. It is then said to be morbidly adherent. In some cases the placental tissue has invaded the myometrium and so cannot be removed without injury to the uterus. This condition is called *placenta increta*.

So long as the placenta is everywhere adherent, blood-vessels are not opened and, therefore, blood does not escape ; but, if the placenta is adherent over only a portion of its extent, hæmorrhage will occur where separation has taken place. As the presence of the placenta in the uterus prevents complete retraction, hæmorrhage will continue till the whole placenta is separated and delivered.

The diagnosis from hour-glass contraction can be made only by an examination showing the absence of any obstruction to the egress of the placenta. On attempting to separate the placenta by the hand it will be found to be densely adherent to the uterus by tough bands. A placenta succenturiata may be morbidly adherent.

Contraction Ring, Hour-glass Contraction of the Uterus.—

This is an occasional cause of delay in the third stage of labour. The contraction ring is most likely to occur after prolonged labour with intra-uterine manipulations, and may also follow the administration of ergot or pitocin before the uterus is empty. The part above the ring may be relaxed except when the condition is due to pitocin or ergot, the whole uterus then being contracted.

This condition can only be diagnosed on internal examination, by feeling the contraction ring as a tight band constricting the uterus below the placenta.

Rupture of the Uterus.—The placenta may escape through a laceration into the peritoneal cavity, and then its delivery *per vaginam* is impossible. Such cases are very rare, and other more important symptoms of rupture are present.

TREATMENT

If delay in the delivery of the placenta is accompanied by bleeding, the treatment will be that of postpartum hæmorrhage before delivery of the placenta (see p. 478).

In cases unaccompanied by hæmorrhage the treatment is not urgent, and extra time must be allowed for the natural processes of separation and expulsion, as the most common cause of the delay is deficient uterine retraction. If from the diminished size, increased

mobility, and raised position of the fundus, together with lengthening of the umbilical cord, it is known that the placenta is merely lying in the vagina, it can be pushed out by pressing the fundus downwards, and backwards, the retracted uterus being used as a piston, or by cord traction.

Intra-uterine retention of the placenta for more than an hour suggests that there is either considerable morbid adhesion, or else that hour-glass contraction is present. In this case it is desirable that the

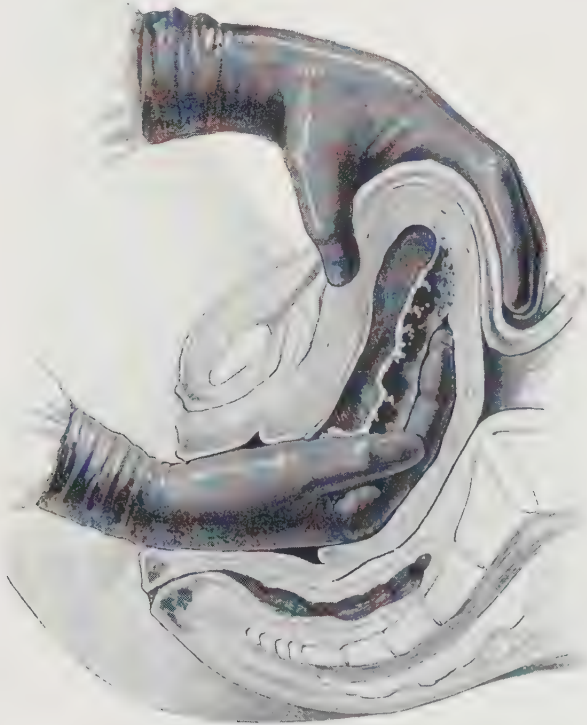


FIG. 188.—MANUAL REMOVAL OF THE PLACENTA.

In this case the separation had begun at the lower edge of the placenta, and so was continued by the fingers up to the top.

placenta should be manually removed under anæsthesia. To do this, one hand makes counter-pressure on the fundus of the uterus through the abdominal wall, otherwise the uterus may be torn from the vagina. The other hand is inserted into the vagina and follows the umbilical cord up to the placenta. If any portion of the placenta has already separated, a start should be made at that area to separate the rest of the placenta by making a saw-like movement behind it (Fig. 188).

If it is very adherent it may have to be removed in pieces, and the membranes stripped off. Instruments must not be used in removing the placenta.

If a line of cleavage cannot be found and the diagnosis of placenta increta is made, there is great danger of perforating the uterus. The safest method of treatment is by hysterectomy, but some authorities advise leaving the placenta *in utero* and awaiting its disappearance by lysis.

If a contraction ring bars the way, the fingers should be withdrawn and two 5-minim (0.3 c.c.) capsules of amyl nitrite broken under the anæsthetic mask. This will generally cause relaxation of the contraction ring and the placenta may then be removed manually.

Retention of the Membranes.—In cases in which the obstetrician has attempted to hurry the third stage without giving time for the contractions of the uterus to separate the membranes from the uterine wall, there is a tendency for the chorion to adhere to the uterus and not separate. It is a common practice to twist the membranes into a rope; the tension thus produced may be sufficient to separate them if they are only slightly adherent, but if firmly attached this manœuvre has the disadvantage that they become torn at the point of attachment, and thus a portion is retained in the uterus. If the chorion appears to be adherent, it is best to hold the membranes untwisted under slight tension; the contractions and retraction of the uterus complete the separation. If the chorion breaks during delivery of the placenta, the lower end of the torn piece may be caught in a pair of artery forceps, by which traction can be made by a rocking movement, when the portion becomes loosened. If on examining the membranes it is found that a considerable piece is missing, it is permissible to make a vaginal examination and feel if any membrane is protruding from the cervix. If membrane cannot be felt, no attempt at intra-uterine examination should be made. The retention of a piece of chorion in the uterus does not give rise to any symptoms as a rule, the chorion disintegrates and comes away with the lochia. The possible effects of a retained piece of chorion are subinvolution with persistent red lochia or infection. Of these the last is the only serious sequel and, therefore, the essential thing is a perfect aseptic technique in such a case.

CHAPTER XXXVIII

TUMOURS COMPLICATING PREGNANCY, LABOUR AND THE PUERPERIUM

PREGNANCY is occasionally complicated by tumours of the uterus itself or of one of the other pelvic organs or even of the pelvic bones. The more common complicating tumours are :

1. Fibromyomata.
2. Ovarian tumours.
3. Carcinoma of the cervix uteri.

FIBROMYOMATA

Incidence.—The incidence of fibroids in association with pregnancy is low ; different authors have found an incidence varying between 0·35 per cent. and 0·8 per cent. Although the figure is admittedly low, it is sufficiently high for an appreciable number of cases annually to be seen in a busy maternity department.

The Relations of Fibromyomata with Sterility

(a) *Does sterility cause the growth of fibromyomata?*—Fibroids are very much more common in childless women ; whereas the general sterility rate is about 10 per cent., it is 30 per cent. in women with fibroids. Moreover those sufferers from fibroids who are not sterile are frequently infertile ; the history in such cases is often one of an interval of five to twenty years since the last, and often the only, pregnancy. Thus the tendency to produce fibroids is greater in a uterus which has not fulfilled its normal function ; instead the abnormal results—what might be regarded as a kind of perverted function.

It has been believed for many years that the growth of fibroids is dependant upon ovarian activity ; fibroids undergo a diminution in size after the menopause, whether natural or radiologically induced and after the operation of bilateral oöphorectomy. The last fact has been known since the time when fibroids were treated by bilateral salpingo-oöphorectomy before hysterectomy had been made a safe operation. Recent experimental work suggests that fibromyomata may be due to continuous oestrogen stimulation unchecked and unopposed by the increased secretion of progesterone which occurs during pregnancy.

(b) *Do fibromyomata cause sterility?*—Conception is made impossible by (a) a fibroid polypus ; (b) when the tumour or tumours are so situated as to make coitus difficult or impossible ; (c) when salpingitis co-exists with fibroids. Whether the presence of fibroids, apart from these three complications, hinders or prevents conception is a question upon which gynæcological opinion is divided. But it is clearly of considerable therapeutic importance. In these days when women not infrequently marry in the late thirties or early forties, what answer is to be given to a patient with a relatively small symptomless fibroid who comes complaining of sterility after two or three years of married life? It is difficult to lay down a hard and fast rule, and each case must be considered individually. On the whole it is probably wise to advise myomectomy for tumours larger than a hen's egg, particularly if more than one is found.

The Effects of Pregnancy on Fibromyomata

Certain changes commonly occur to fibroids during pregnancy. First, a change in position and, secondly, pathological changes.

1. *A change in position.*—Fibroids accompany the uterus in its upward growth throughout pregnancy. That is axiomatic. The clinical importance is that fibroids situated in the lower uterine segment before conception almost always ascend into the abdomen afterwards. They rarely remain in the pelvis.

2. *Pathological changes.*—Pregnancy causes several pathological changes in fibroids, the three commonest being œdema, necrobiosis and torsion of the pedicle of a pedunculated subserous fibromyoma.

(a) *Œdema*, due to increased vascularity, leads to a slight increase in size which is probably augmented by slight hypertrophy ; it also causes the tumours to become softer and, often, flatter. The two last-named changes may make them more difficult to feel.

(b) *Necrobiosis* is particularly liable to occur during pregnancy. It is due to hyaline degeneration in the walls of the blood-vessels supplying the tumour ; the weakened walls rupture with a resulting extravasation of blood. The sequential hæmolysis gives the tumour its characteristic red appearance. It is possible to see the red blood-corpuscles under the microscope in necrobiosis, provided the sections are cut soon enough after the occurrence of the degenerative change and before their hæmolysis is complete.

Red degeneration is common during pregnancy occurring in about 15 per cent. of cases. The symptoms and signs, which may be severe, are general and local. The general symptoms are a rise in temperature, a rise in the pulse-rate, malaise and occasionally nausea or even vomiting.

Locally the patient complains of lower abdominal pain which is sometimes of considerable severity. The degenerating tumour is tender and slightly, although scarcely appreciably, larger and softer than it was before the onset of necrobiosis.

(c) *Torsion of the pedicle* of a pedunculated subserous fibromyoma very occasionally occurs.

The Effects of Fibromyomata on Pregnancy, Labour and the Puerperium

Pregnancy.—Miscarriage is sometimes caused by fibromyomata, although it is difficult to be sure that any particular miscarriage is due to this cause. The incidence is probably between 10 and 20 per cent. It is most likely to occur when the situation of the tumour is submucous, least likely when only a single subserous and pedunculated fibromyoma is present.

A fibromyoma, particularly if situated in the posterior uterine wall, may cause retroversion of the gravid uterus; occasionally incarceration with retention of urine results.

Fibromyomata, by interfering with the engagement of the head in the pelvis, may be responsible for malpresentations.

Labour.—*The first stage* of labour. It might, not unreasonably, be thought that fibromyomata would interfere with the uterine contractions and therefore cause the first stage of labour to be prolonged; in fact this rarely occurs, the large majority of cases have a normal first stage.

The second stage of labour. The necessity for delivery with the forceps is increased; in one series of cases the forceps was used in approximately 80 per cent. of cases with fibromyomata, whereas the general forceps rate at the same hospitals was about 13 per cent. Delivery may be obstructed by a fibromyoma which is situated in the pelvis. This is unusual because most fibroids, previously situated in the pelvis, rise into the abdomen during pregnancy.

The third stage of labour may be complicated by postpartum hæmorrhage, especially with submucous tumours; and particularly if the placental site covers the surface of a submucous tumour.

The puerperium.—The chief puerperal complication is infection of a submucous fibromyoma: torsion of the pedicle may occur with pedunculated subserous growths; and the extrusion of a polypoid submucous fibroid has been recorded.

In some cases fibromyomata of considerable size have been known to undergo a great reduction in dimensions during 3 to 6 months after delivery.

Diagnosis

Fibromyomata which are projecting and nodular are easily felt in the wall of the pregnant uterus, and are distinguished from fetal parts by their fixed position. *Fibromyomata* may, however, be very difficult to detect when they have become so fixed and flattened in the uterine wall, that pregnancy in this case the tumours are very unlikely to interfere seriously with pregnancy or labour.

If a woman who is known to have a *fibromyomatous* uterus becomes pregnant the signs and symptoms of pregnancy are sometimes masked. Immature haemorrhages due to threatened abortion may be mistaken for menstrual bleeding. The tumours may make the swelling feel unlike the normal pregnant uterus in shape or consistency, or may make it difficult to feel fetal parts. In cases of doubt the biological tests for pregnancy should be carried out.

There are certain conditions which may simulate uterine fibromyomata associated with pregnancy. These are local contractions of the placental wall, sometimes associated with pain. In such cases the physical signs will be found to have altered at a second examination. A similar mistake may be made when there is an angular gestation, at which the ovum has become implanted close to the junction of one of the Fallopian tubes and uterus, or when there is a double uterus one half of which contains the fetus.

The differential diagnosis between a large symmetrical interstitial fibromyoma and the pregnant uterus may be very difficult, especially when there is amenorrhoea due to the onset of the menopause or other endometrial condition. Especially suggestive of pregnancy are marked softening of the cervix, or contractions and relaxations in the uterus. After the seventh week the biological pregnancy tests will be useful, and fetal bones can be shown in an X ray after the 16th week. Cases of tumours made in which the biological tests may be negative will give rise to difficulty. Repeated examination will reveal the presence of a living fetus, by the rapid growth of the uterus.

Treatment

Pregnancy.—Most women with *fibromyomata* pass through pregnancy without difficulty or serious symptoms. An expectant line of management is, therefore, the wisest. The pregnancy should be carefully supervised and a watch kept for untoward symptoms.

Thrombotic menorrhage should be treated on orthodox lines (see page 235).

Myomata sometimes causes severe, even very severe, pain requiring admission to hospital. The pain and other symptoms almost

invariably subside within a week or 10 days in bed and the administration of morphia and other analgesic drugs. It is not an indication for myomectomy during pregnancy. Indeed, there are four good reasons against this operation. First, patients with fibromyomata are relatively infertile and operation frequently involves risking the patient's only opportunity of motherhood. In one series of 189 cases no less than 155, or 82 per cent., were pregnant for the first time. Secondly, operation is frequently followed by miscarriage. Thirdly, although the abdomen is opened with the intention of performing myomectomy, the local conditions may be such as to demand hysterectomy; or myomectomy may be possible only after the removal of the products of conception. Fourthly, the morbidity and mortality risks of myomectomy are undoubtedly increased by the co-existence of pregnancy. The fibromyomata are less easily removed because the plane of cleavage between the tumours and their capsules is less well defined; while hæmorrhage is more profuse and often exceedingly difficult to control.

Torsion of the pedicle of a pedunculated subserous fibromyoma and *incarceration* of a retroverted uterus containing a fibromyoma, which cannot be replaced after catheterizing the bladder are two extremely rare complications in which laparotomy is indicated. It is also indicated in the even more extremely unusual cases of *torsion of the pregnant uterus* and *intraperitoneal hæmorrhage*, due to rupture of a vein on the surface of a large fibromyoma. But all these four complications are pathological rarities which may not be seen during the life of many gynecologists.

Labour.—All pregnant women with fibromyomata should be confined in hospital. Towards the end of pregnancy, usually about the 36th week the important decision as to the method of delivery will have to be made. First, whether it is to be vaginal or abdominal; and, secondly, if abdominal, whether hysterectomy or myomectomy should be combined with the Cæsarean operation.

Positive indication for Cæsarean section.—In cases in which a fibromyoma is situated in the pelvis and offers obstruction to delivery *per vias naturales* Cæsarean section is imperative and should be performed shortly before term. Such cases are uncommon; because, as has already been pointed out nearly all fibromyomata rise into the abdomen during pregnancy.

General considerations.—In the other cases, which form the large majority, it is difficult to specify which patient should be allowed to deliver herself normally and which should be treated by Cæsarean section. Natural delivery would be chosen in the case of a single small fibromyoma situated in the upper uterine segment; whereas in the

case of a large number of tumours Cæsarean section with hysterectomy would be the practice of most gynecologists. But the majority of cases lie between these two extremes and each must be judged on its own merits. There are, however, certain considerations which should be borne in mind when making a decision on this important question.

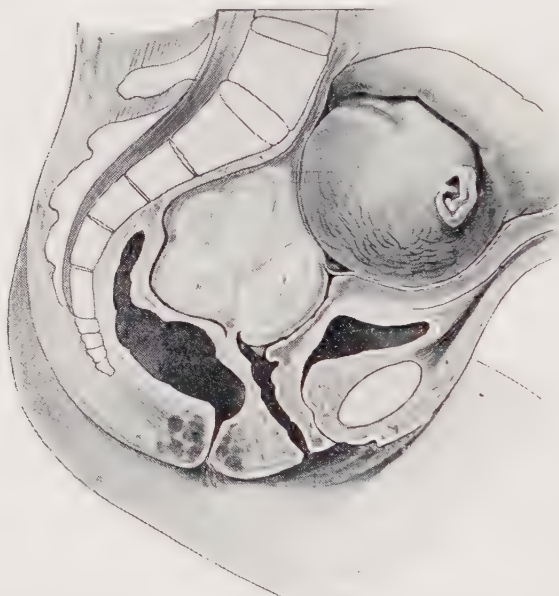


FIG. 189.—FIBROID TUMOUR OF THE CERVIX WHICH PROVED AN INSUPERABLE BAR TO DELIVERY BY THE NATURAL PASSAGES.

First, it must be remembered that labour is often uncomplicated. In cases of doubt the sensible course to pursue is to allow labour to begin normally, being ready to interfere, should circumstances necessitate interference, by Cæsarean section in cases of uterine inertia during the first stage; or by the application of the forceps when the second stage is delayed.

Secondly, failure of the head to engage before the onset of labour in a primigravida, or a malrepresentation, would weigh the scales heavily in favour of Cæsarean section.

Thirdly, the age and parity of the patient have an important bearing on the question. So often the pregnancy is the first at an age when the prospects of future child-bearing are steadily diminishing. Moreover many of these patients have been married for some years, often for many years, before the present pregnancy. These three are valid reasons in favour of delivery by Cæsarean section.

Fourthly, the larger the number and the greater the size of the tumours, the stronger is the indication for abdominal delivery.

Cæsarean section with hysterectomy or myomectomy.—If the decision reached is to deliver the child *per abdomen*, should the fibroids be dealt with at the same operation and if so by myomectomy or by hysterectomy? Cæsarean section with myomectomy is a procedure to be avoided, because it is fraught with very considerable risk owing to the torrential hæmorrhage which takes place from the cavities left after the enucleation of the fibromyomata; even after apparently complete closure and obliteration by mattress-sutures hæmorrhage often continues from the stitch-holes and suture line. In theory it should be possible to arrest the bleeding; in practice it is frequently impossible.

Myomectomy immediately after Cæsarean section is advisable only in the case of a pedunculated tumour, and when the fibroids are of insignificant size, or few in number. The operation of Cæsarean section with myomectomy should be regarded with awe. In those cases in which operative delivery has been decided upon but which are unsuitable for myomectomy there are only two alternatives: either to deliver the child by Cæsarean section, leaving the fibroids to be dealt with later, or to remove the uterus with its tumours. The most sensible course is to remove the uterus in those cases in which myomectomy would be impossible at a later date and to conserve it with its fibroids when there is a reasonable expectation of safely performing myomectomy after involution is complete and after an interval of 6 months. Certainly it would be ill-advised to attempt it with an interval of less than 3 months.

OVARIAN TUMOURS

Incidence.—Ovarian tumours are not commonly associated with pregnancy, the incidence being somewhat less than 1 in 1,000 cases, about 0.1 per cent.

Type of Tumour.—The commonest ovarian tumours associated with pregnancy are simple unilocular or multilocular cysts and dermoid cysts. The relative incidence of the former is between 60 and 70 per cent. and of the latter 20 to 25 per cent. Papillary cystadenomata, ovarian fibromata and chocolate cysts very occasionally occur.

The Effects of Pregnancy on Ovarian Tumours.—In about 12 per cent. of pregnant patients torsion of the pedicle of an ovarian tumour occurs, while the incidence is about 8 per cent. in non-pregnant patients.

Rupture of the cyst, intracystic hæmorrhage, infection and necrosis can occur but are not any commoner among pregnant than among non-pregnant patients. Injury and necrosis may result from pressure on the tumour during labour. During the puerperium the pedicle is liable to become twisted owing to the rapid decrease in the size of the uterus; the laxity of the abdominal walls after delivery may be another factor predisposing to torsion. Infection and suppuration also occasionally occur.

The Effects of Ovarian Tumours on Pregnancy.—Usually pregnancy continues undisturbed by an ovarian tumour but miscarriage may occur owing to interference with uterine growth.

Labour will be obstructed by a tumour situated in the pelvis: obstruction is relatively more common than with fibromyomata which nearly always ascend into the abdomen before it begins.

Diagnosis.—The possibility that a tumour rising from the pelvis into the abdomen may be a full bladder must always be eliminated by catheterization.

In the early months of pregnancy the uterus is easily differentiated by bimanual examination from the rounded and probably movable pedunculated ovarian tumour lying behind and to one side of it, but occasionally there is difficulty. A valuable sign when it can be obtained is the periodical contraction and relaxation of the pregnant uterus.

The chief condition which will have to be distinguished from an intra-pelvic ovarian cyst associated with early pregnancy, is retroversion of the gravid uterus. An ovarian tumour is usually displaced to the one side, is cystic and tense while the cervix points downwards; whereas the retroflexed gravid uterus is central and soft and the cervix points forwards.

An ovarian tumour complicating pregnancy may occasionally be mistaken for an ectopic gestation, but this does not matter since laparotomy is the correct treatment in either case. The combination of a twisted ovarian cyst lying in the pouch of Douglas with a threatened abortion may be very difficult to distinguish from a tubal abortion. In all cases of doubtful diagnosis, in which there is any question as to the correct treatment to pursue, a careful examination should be made under anæsthesia.

In the later months of pregnancy, if an ovarian tumour lies in the pelvic cavity, it is easily distinguishable, but care should be taken to exclude tumours of the pelvic colon.

If the tumour is adherent to the uterus, twins, myoma, bicornute uterus, or even hydramnios may be simulated, and here again it may be necessary to make a careful examination under anæsthesia.

Treatment.—An ovarian tumour should be removed as soon as it is diagnosed whether the patient is pregnant or not, except during the first 12 weeks of pregnancy, because it may be malignant, or it may become malignant. Moreover while the tumour remains in the peritoneal cavity it is subject to the risks of torsion of the pedicle, rupture, intracystic hæmorrhage and other secondary changes.

When pregnancy co-exists an ovarian tumour should always be removed if diagnosed during the first half of gestation, for the reason that the tumour is potentially, if not actually, malignant. When the diagnosis is made in the very early weeks it is preferable to delay operation until after the 14th week because the danger of miscarriage is then less than it is during the first 12 weeks; the placenta having taken over the hormonal activities of the ovaries about that time.

When the diagnosis is not made until late in the pregnancy, either Cæsarean section with removal of the ovarian cyst should be carried out shortly before term; or natural delivery should be allowed to occur at term and the cyst removed during the puerperium. With an intrapelvic tumour which will obstruct delivery the former method should be selected; in those in which it is not offering obstruction the latter may be the treatment of choice.

CARCINOMA OF THE CERVIX UTERI

Cancer of the cervix is a very rare complication of pregnancy, labour and the puerperium. It is found almost exclusively in parous women and is a very dangerous complication. The comparative rarity of the complication is due to the fact that the disease usually occurs in the later years of menstrual life when pregnancy is less likely to occur. The vaginal discharge that accompanies the disease in its later stages, doubtless tends to prevent conception, but in the early stages there is probably but little influence of this kind. Pregnancy is unknown with carcinoma of the body of the uterus, but it has been known to occur in association with sarcoma of the uterine body. Chorion-epithelioma may invade the walls of the uterus during pregnancy.

Diagnosis.—Whenever a woman who is pregnant has irregular hæmorrhage, or a purulent or foetid vaginal discharge, she should be examined *per vaginam*, since the cause may be carcinoma of the cervix. The diagnosis is made by the usual criteria of this disease. Close attention should be paid to any friable tissue in the cervix of a woman advanced in pregnancy lest an early case of carcinoma of the cervix should be missed. When there is any doubt as to the diagnosis, a small piece of

the friable tissue should be removed for examination under the microscope. Abortion does not necessarily follow this procedure.

When the growth is endocervical the diagnosis in early cases is not so easy, since intermittent hæmorrhages will be the only clue to the diagnosis and confusion may arise between endocervical cancer and antepartum hæmorrhage, that is to say hæmorrhage from the placental site.

Treatment.—If the growth is in an early stage immediate radical hysterectomy is the best treatment. In the early weeks of pregnancy this can be performed without emptying the uterus, but in other cases hysterotomy or Cæsarean section would be the first step of the operation. Some surgeons would prefer to treat such early cases with radium, but the uterus would first have to be emptied by hysterotomy or Cæsarean section, and delay would be inevitable before the radium could be inserted.

In cases in which the growth is so advanced that radical operation is impossible the uterus should be emptied by hysterotomy or Cæsarean section, so that treatment with radium and X-rays can be given. Delay in treatment in the foetal interest would only be justifiable in an advanced case in which the maternal prognosis was already very bad.

The dangers of allowing natural labour to take place are severe hæmorrhage, rupture of the uterus, and puerperal sepsis.

CHAPTER XXXIX

THE RELIEF OF PAIN IN LABOUR

THE amount of pain experienced in labour varies enormously from patient to patient. Some women find that labour is almost painless whilst others complain of unendurable agony. Some, therefore, will need minimal doses of analgesic drugs and others demand much more. The degree of pain appears to have no direct relation to the strength of the uterine contractions or to the mechanical difficulties of the case. With many patients the first stage of labour is more painful than the second and primary uterine inertia especially tends to be painful.

In most cases the pain of parturition is due to fear and ignorance. The Victorian tradition—well based in its day—of difficult, agonizing and often fatal child-bearing, has influenced our folklore. Fear and apprehension about the outcome of labour are latent or frankly obvious in the majority of primigravid patients and in some multiparous patients who have had unfortunate experiences.

The antenatal patient is frequently disturbed by gossip in waiting rooms where horrific stories and experiences are often recounted. Elderly relatives who are long past their child-bearing frequently take delight in telling tales of agony and disaster. In the lives of most women child-bearing is the most important episode and many of these tend to dramatize their experiences. The old campaigner who recounts vivid stories of battles is not always the winner of medals! And there are some women who could vie with Baron von Münchhausen.

In country districts this fear-making propaganda seems to be most potent and an interesting collection of old wives' tales can be made. Such fear-making sources of information can be counteracted by the discerning physician who will, at the same time, increase his knowledge of the popular prevailing misconceptions. To try and laugh off the old wives' tales is the worst thing to do. They must be taken seriously for they are serious to the patient, but given confidence she can be educated into a happy frame of mind. From patients who have been delivered and whose confidence has been obtained much valuable information can be obtained as to their problems and what helped or failed to help them. It must be remembered that antenatal care is the product of the present century. Before that the antenatal patient gleaned her information about labour from older women and from

friends who had had babies. It is probably true to say that the antenatal patient of today is more enlightened than her mother and this is one reason why labour has fewer terrors now than formerly.

The most important factor which will help the patient during the antenatal period and labour is having a doctor or midwife in whom complete and quiet confidence can be placed. A person who is sympathetic, can answer all problems simply and, more important, divine underlying thoughts and worries and so help the patient to unburden herself. This is largely a question of temperamental compatibility. To overcome a background of fear it is necessary first to change the patient's mental approach to labour. The practice of referring to uterine contractions as pains unfortunately perpetuates this fear. The doctor should think, and attempt to teach his patients to think, in terms of what is now called the psychosomatic approach. The influence of the cortex on the vegetative nervous system and the effect of cortical excitation and inhibition should be explained in simple terms. The patient can readily be made to understand that suggestion can both cause and prevent pain. She will understand that nervous tension can produce physical tension and that this physical tension may result in inco-ordinate and obstructive muscular contraction. The realization of this will allow her to accept the idea that a relaxed mind and a relaxed body will make labour easy.

It is important for the patient to have some understanding of the anatomy, physiology and mechanism of labour. Many patients do not understand that the first stage of labour is long in relation to the second and that it is devoted only to the opening up of the birth-canal and not, therefore, rewarded by a sensation of foetal descent. This leads to a fear that labour is not progressing normally, to a feeling of frustration and so to the development of uterine inertia. At the back of every woman's mind is a natural fear of obstructed labour or, as she probably thinks of it, a doubt that so large an object as a baby can come through so small an organ as the vagina. Explanation of the mechanism of labour in simple terms will do much to overcome these fears. The patient should be taught how to use relaxation and correct breathing in the first stage of labour and so allow the contractions to pass without her attempting to take an active part by bearing down. She should be taught to use the contractions of the second stage employing the respiratory rhythm: breathe in—breathe out—breathe in—hold your breath—push . . . until she is told to change to a slow, deep-breathing rhythm during the birth of the head.

Doctors and nurses at antenatal clinics should be especially careful not to make indiscreet, disturbing or confusing remarks. The aim

and object of antenatal care is to remove all removable fears and worries from the patient. This includes imparting such information as will make pregnancy a happy experience and the birth not an unknown nightmare but a new experience about which she is fully briefed. It is obvious that unnecessary discussions in the presence of the patient about correctness of dates, the position of the child, engagement of the head, the level of the blood-pressure or any other factor which could be constructed by the patient as meaning 'something is wrong' must be avoided. If such discussions are necessary for teaching purposes then that fact must be pointed out to the patient and she must be told that she is quite normal, if that is the case. The discussion otherwise should be held out of earshot of the patient. All this is very obvious but not always remembered. In particular, pupils and other inexperienced attendants should be most guarded in their remarks and in the way they examine patients.

During labour any fear or apprehension becomes maximal and what has been said about the conduct of attendants during antenatal visits becomes increasingly important during labour.

Patients after delivery will often say that the most reassuring factor is the knowledge that her chosen antenatal attendant is close at hand when wanted or present the whole time, to give assurance, answer questions and order analgesic drugs if and when required. Care should be taken by the attendants not to leave the patient alone in a closed room or to allow her to overhear and possibly misconstrue their medical remarks, conversations and discussions of abnormalities of labour. In an abnormal labour the patient's emotional reaction must be carefully studied; any sign of anxiety or failing confidence must be countered by a clear-cut programme and a worried or puzzled look must be avoided in her presence. The importance of these generalizations can be learnt from the experiences of multiparous patients. From all this it is obvious that the ideal arrangement would be for every pregnant woman to have attendants in whom she has complete confidence and who will attend her throughout pregnancy and labour. With the vast majority of women this is impossible. An attempt is made to bridge the gap and solve the problem by inviting the antenatal patients to attend lectures and demonstrations organized by the antenatal department. These are still in the experimental stage and so vary from clinic to clinic. Some centres have a most comprehensive course with numerous lectures and demonstrations, others are less elaborate. It can clearly be debated whether the maximal or minimal amount of information should be imparted. The choice depends on the views of departmental personnel and the capacity of the patients to absorb information.

The patient should also receive instruction in the use of the analgesic apparatus which will be available. She should not use apparatus in labour without previous training.

The Use of Analgesics and Anæsthetics in Labour

The requirements of an ideal analgesic agent are:—

1. It should not harm or endanger the life of the mother or affect her co-operation.
2. It should not decrease uterine contractions.
3. It should not occasion more frequent operative intervention.
4. It should not harm the baby by interfering with the establishment of respiration at birth.
5. It should be easy to administer and be foolproof.
6. It should have uniformly successful results.

As no such agent has yet been discovered a wide variety of drugs is in use and practice varies from hospital to hospital.

Drugs Commonly Employed.

(a) IN THE FIRST STAGE OF LABOUR

Potassium bromide, chloral hydrate, tinctura opii.—These drugs are less often used than formerly. It was routine practice to prescribe a mixture containing potassium bromide gr. 20 and chloral gr. 30 to which was frequently added tinct. opii m. 10-15. Such a mixture was given early in labour as a sedative but to obtain full effect repeated doses were necessary. The mixture sometimes induces vomiting and absorption of drugs from the alimentary canal is, in any case, uncertain during labour.

Barbiturates.—These drugs have been known since 1903 but only during about the last two decades have they been used in obstetrics. Essentially they are hypnotic drugs and only analgesic in anæsthetic doses. Pharmacologically they all have a similar action but are grouped according to their speed of action. The long acting group was first discovered. Phenobarbitone is an example; its action is too slow for use in labour although it is employed antenatally and during the puerperium, particularly in the presence of pre-eclamptic toxæmia. The ultra short acting group is widely used in anæsthesia, thiopentone and hexobarbitone being examples.

Pentobarbitone (nembutal), a short acting barbiturate and sodium amytal, a medium acting barbiturate, are both used during labour. Either of these drugs given in a dosage of gr. 3 is most valuable as a hypnotic for a patient in whom labour is not properly established,

Their value in well-established labour is still debated. Those who favour their use give gr. 3 to 6 when the cervix commences to dilate and half the initial dose is given about 4 hours later. Hyoscine or chloral is frequently prescribed in addition. There are disadvantages, however, in using the barbiturates. Absorption from the intestine may be erratic in established labour and the respiratory centre of the newborn baby may be depressed, because the barbiturates pass the placental barrier. Restlessness and excitement with loss of control increase with large doses and labour may be prolonged. For these reasons the barbiturates seem to have little place in domiciliary midwifery.

Pethidine.—This is also known as demerol, dolantin and meperidine. It is a synthetic drug discovered in 1939. Pharmacologically it is an analgesic having about a tenth of the effect of morphine on pain. It has an antispasmodic effect on smooth muscle, a papaverine-like action, and an atropine-like effect on nerve endings, depressing cholinergic nerve supply to smooth muscle. Sedative effects are less marked than with morphine. Rarely the patient may become apprehensive. Although it was claimed that pethidine had no depressant effect on the baby's respiration, this is not always the case. A few years ago pethidine was issued in tablet form and given orally. The effects were very variable, a disadvantage common to all drugs when reliance is placed on absorption from the alimentary tract during labour. Now the drug is issued in ampoules of pethidine hydrochloride for intramuscular injection. The usual dose is 100 mg. which may be repeated in 4 hours. A total dose of 100-200 mg. is commonly employed, though in some hospitals much larger doses are given.

It should be remembered that pethidine is a habit-forming drug and that it comes under the *Dangerous Drugs Act*. However, midwives acting alone are allowed to administer the drug, the total dosage being controlled. Pethidine is at present widely employed for obstetric analgesia. It is sometimes combined with hyoscine hydrobromide, gr. 1/150-1/100 to increase the sedative effect.

Morphia.—This valuable analgesic is not used so frequently as it might be, particularly during a prolonged first stage. Formerly it was the practice to give morphia gr. $\frac{1}{4}$ to nearly every primigravida, when the cervix was 2 or 3 fingers dilated. There is a widely-held view that morphia is responsible for marked respiratory depression in the baby. Certainly if the morphia is given within 4 hours of delivery, then respiratory depression is attributable to morphia. However, respiratory depressive effects from morphia, omnopon or pethidine can now be neutralized by the use of a new drug, N-allylnormorphine hydrobromide (lethidrone). This drug was first prepared

in 1941 and was found to antagonize the respiratory depression produced by morphine. Administered by itself N-allylnormorphine acts as a depressant of respiration and circulation. N-allylnormorphine does not counteract respiratory depression produced by barbiturates, cyclopropane, ether or any drug not chemically related to morphine.

Dramatically good results have been obtained by injecting 1 mg. of N-allylnormorphine hydrobromide into the umbilical vein of the hyponœic new-born child. One milligram is issued as a solution in a 2 ml. ampoule. This drug may also be administered to the morphinized mother shortly before delivery.

Morphine sulphate gr. $\frac{1}{4}$ combined with hyoscine hydrobromide gr. 1/100 is of the greatest value in securing sleep during an abnormally long first stage.

Omnopon gr. $\frac{1}{3}$ combined with hyoscine gr. 1/150 is a less powerful combination indicated in similar circumstances.

Paraldehyde is a safe and effective basal narcotic and is only slightly depressant to the respiration. It raises the pain threshold. It acts slowly and for a long time and is excreted slowly. It does not affect the foetal respiration to any marked degree. The main objection is its smell. It can be administered per rectum. Paraldehyde 4 drachms is shaken up in 1 to 1½ ounces of olive oil or saline. A catheter is introduced into the rectum and pushed up above the presenting part and the paraldehyde then run in. More conveniently 5 to 10 c.c. supplied in ampoules, can be given intramuscularly. Paraldehyde is not often used in normal labour but it should be remembered and is valuable in patients who are nervous and difficult to control in the first stage of labour. It is frequently used in the treatment of eclampsia.

(b) IN THE SECOND STAGE OF LABOUR

Nitrous oxide and air, commonly referred to as 'Gas and Air'. This is self-administered by means of a Minnitt's or similar apparatus. Midwives are permitted to supervise its use, provided they hold a certificate of training in its use and that the patient has been examined by a doctor and has been certified as fit for such an administration. Originally the machine delivered 35 per cent. of N_2O with 65 per cent. of air. As this was not always sufficiently potent the proportions were changed to equal parts of N_2O and air. As only a fifth part of air is oxygen this mixture allows 10 per cent. of oxygen in the inhaled mixture. This would induce anoxia if administered continuously and therefore only intermittent use is permissible. This oxygen content is the limiting factor and unfortunately for some patients 50 per cent. of nitrous oxide is insufficient to produce analgesia. There have been

modifications of the machine, either to deliver pure N_2O for one or two breaths, then the usual gas-air mixture, or to deliver N_2O and oxygen, but none have been generally accepted as satisfactory.

It must be emphasized that the percentage of successes with gas-air analgesia will be greatly increased if the patients are shown the apparatus before the expected date of confinement, and not for the first time when they are actually in labour. They should be instructed in its use and shown how to apply the mask firmly to the face and how to close the safety air intake with the finger. They must know that in order to gain full benefit they must start to use the machine as soon as a contraction is felt to be commencing and not when it has become established. During labour it must be ascertained that patients have remembered all these points. If necessary there must be a repeated explanation of the machine's use.

Nitrous oxide and oxygen.—The mixture must consist of not less than 20 per cent. of oxygen if anoxia is to be avoided. To ensure that the proportions are correct an accurate machine is required, fitted with flow meters. Many types of machine have been devised. The common Boyle's machine is a continuous-flow apparatus. This means that when the gases are turned on they flow continuously from the face-piece. The Walton and McKesson machines are of intermittent flow type in which the gases leave the face-piece only when the patient inspires through it. These pieces of apparatus must be under the control of an anæsthetist, when general analgesia or light anæsthesia can be induced at will.

There is at present no machine in general use for the self-administration of nitrous oxide and oxygen.

Chloroform.—This is now out of fashion. Formerly it was in common use and had the advantage of being easily administered and absorbed. It reduces the strength of uterine contractions and, unhappily also, there have been many fatalities when it has been used unskilfully. The prolonged or repeated use of chloroform, even in minimal concentration, may cause fatal delayed chloroform poisoning. Its use is especially to be condemned in cases in which the liver may already be damaged, as in toxæmia of pregnancy. Its portability, low volatility and non-inflammable character still give it a place in emergencies in domiciliary midwifery when other methods are not available, or in the tropics.

Trichlorethylene (Trilene).—This chemical has been known since 1864 and has been used in industry as a fat solvent. Its analgesic properties have been known since 1915. It was first used as a general anæsthetic agent in 1935. It is a colourless liquid with an odour resembling chloroform. It is non-explosive. It is stored in amber

glass bottles, because it decomposes in sunlight. Soda lime also causes it to decompose; therefore it must never be used in a closed circuit anæsthetic machine. It is issued as the proprietary preparation "trilene" which is trichlorethylene, coloured blue for identification purposes by waxoline blue. Pharmacologically it resembles chloroform in its effects but has a less depressant action on the heart and circulation. In excessive dosage it depresses respiration. Most of the drug is excreted unchanged through the lungs. In obstetrics 0.5 to 0.65 per cent. trichlorethylene in air is delivered to the patient. Many



FIG. 190.—FREEDMAN'S INHALER.

(British Oxygen Company)

pieces of apparatus have been devised to allow the self-administration of the mixture. That most commonly used is the Freedman inhaler or Woodfield Davies' modification. This apparatus cannot be overfilled, can be clamped to the bed and delivers approximately 0.65 per cent. trilene in air by a simple draw-over procedure. Sometimes trilene is used in a Rowbotham bottle from which, by means of a lever, the concentration of trilene can be varied by an attendant. It has the advantage that it can be self-administered and in most patients it produces satisfactory analgesia without decreasing the strength of the contractions or affecting the baby—in the concentration delivered from the Freedman apparatus.

Anæsthesia for Operative Deliveries

For operative deliveries, whether abdominal or vaginal, a number of methods of anæsthesia and agents are available. Certain basic considerations must be observed. Firstly, the agents used must not depress the baby's respiration at birth, so morphia and allied drugs

must not be given as premedication. Secondly, the lower segment operation for Cæsarean section (now a routine) needs a deeper relaxation during the preliminary dissection and probably calls for a longer time between induction of anæsthesia and delivery of the baby. Luckily its increasing popularity has coincided with the introduction of muscle-relaxant drugs and the practical difficulties of the anæsthetist are now lessened. The circumstances of the delivery and the skill of the attendants determine the choice of anæsthetic.

(1) GENERAL ANÆSTHESIA is frequently employed.

Nitrous oxide, oxygen and ether or trilene are commonly used when apparatus is available. The use of pentothal, cyclopropane and oxygen or relaxants is left to the decision of the skilled anæsthetist.

Open ether using a "rag and bottle" technique still has its place when anæsthetic apparatus is not available. Induction can be effected by a chloroform-ether mixture (C2 : E3) or by ethyl chloride.

DANGER OF GENERAL ANÆSTHESIA IN OBSTETRICS

A number of fatalities occurs every year from the inhalation of vomitus. The patient in labour usually has gastric stasis and during light anæsthesia vomiting readily occurs. It was less common when quick induction and deep anæsthesia were the practice.

Prevention.—The inhalation of vomitus can be prevented by withholding solid food during labour. In some hospitals it is the rule that the stomach must be emptied by tube prior to the induction of general anæsthesia.

Treatment.—The patient is tilted head down so that the vomitus can flow out of the mouth rather than down the trachea; and the vomitus is removed from the nasopharynx by a mechanical sucker, if available. On such occasions it is desirable to have a labour ward bed which can be rapidly tilted head down.

After-care.—Respiration should be carefully observed following vomiting during anæsthesia lest there should be collapse of the lungs, active early treatment of which is essential.

(2) REGIONAL ANALGESIA. In some hospitals this is preferred to general anæsthesia.

Spinal analgesia. Saddle-block low spinal analgesia is used in some cases for forceps delivery. The use of spinal analgesia for abdominal delivery is a matter of considerable controversy; it should certainly be treated with great circumspection.

Continuous caudal analgesia.—When the first stage of labour is established a dilute local anæsthetic solution—procaine, or better piperocaine hydrochloride (metycaine)—is introduced by means of a malleable needle inserted through the sacral hiatus, so that the tip lies in the extradural space. Further amounts of the solution are injected intermittently as required. Used successfully in a normal labour there is no pain. Uterine contractions are unaffected but the voluntary expulsive efforts in the second stage are poor, usually necessitating a low forceps delivery. The baby is unaffected and blood-loss is minimal. Against this must be weighed first the difficulty, or even danger, in inserting the needle; secondly, the need for constant supervision by personnel trained in the use of caudal analgesia and its complications; and thirdly, the increased forceps-rate. It is obvious that the method has no place in domiciliary obstetrics. It must be confined to hospital deliveries and even then can only be applicable to a minority of patients because of lack of the trained personnel and the expense of equipment.

Local infiltration and pudendal block.—As an alternative to inhalation anæsthesia local anæsthesia offers the following advantages :

1. It does not affect the baby.
2. It does not affect the uterine contractions.
3. It does not carry the risks involved when vomiting occurs during anæsthesia.
4. It can be used by a single-handed obstetrician when no anæsthetist is available.
5. It encourages gentleness during obstetric vaginal operations.

Obviously no method of relieving pain can be absolutely safe and the risks involved in the use of local anæsthetics are overdosage, individual idiosyncrasy and accidental intravenous injection.

Not all patients are temperamentally suited to this type of analgesia; nervous and emotional women are unsatisfactory subjects. Intelligent and co-operative persons who will accept an honest explanation of what is being done are ideal subjects for this method of anæsthesia.

Local Anæsthetic Agents

With the introduction of lignocaine (xylocaine) in the place of procaine the efficiency of pudendal block has increased. A 1 per cent. solution of lignocaine is adequate for obstetric local anæsthesia and if larger volumes are used 0.5 per cent. is safe. The addition of adrenalin is not necessary because the duration of action of lignocaine is sufficient for the obstetric operations for which it is employed. Hyaluronidase

added to the anæsthetic solution appears to have no special advantage and is more likely to reduce the duration of action by speeding the rate of absorption.

It should always be remembered that there is a maximal dose of local anæsthetic drugs which may be injected. For lignocaine this is 0.5 g., or 50 ml., of a 1 per cent. solution, or 100 ml. of a $\frac{1}{2}$ per cent. solution. These quantities must not be exceeded, so the volume at various sites of injection should be planned in advance.

Uses :

1. Normal (spontaneous) delivery.
2. Repair of perineal laceration and episiotomy.
3. Low forceps delivery.
4. Assisted breech delivery.
5. In selected mid-forceps delivery and manual rotation of the head.
6. In twin labour if the patient is able to remain conscious during operative delivery of the first twin, then if the second presents by the breech, the mother will be able to make expulsive efforts and diminish the risk of breech extraction (or of waiting for consciousness to be recovered).

Anatomy.—The pudendal nerve is derived from the 2nd, 3rd and 4th sacral nerves. These branches usually unite just above the ischial spine. The nerve passes out of the greater sciatic foramen posterior to the ischial spine and enters the lesser sciatic foramen. It then enters the pudendal canal ; the vessels lie lateral to the nerve.

The nerve divides into :

1. *The inferior hæmorrhoidal nerve* giving branches to the rectum, internal anal sphincter and the skin around the anus.
2. *The perineal nerve*, the largest branch, supplying the skin of the perineum, labia majora and the muscles of the superficial and deep perineal groups.
3. *The dorsal nerve of the clitoris* supplying the clitoris and labia minora.

Sometimes fibres from the posterior femoral cutaneous nerve and the ilio-inguinal nerve may supply this region.

Technique.—Using 1 per cent. lignocaine a skin weal is raised halfway between the anus and ischial tuberosity. The index finger of the left-hand is inserted into the vagina and the ischial spine palpated (the ischial spine may also be located by rectal examination). A 5 inch 20 gauge needle is used for the block, being passed through the skin weal and directed towards the ischial spine. The tip of the needle is palpated by the finger in the vagina and its relation to the ischial spine determined. The needle is pushed just posterior to the inferior tip of

the spine. The plunger of the syringe (preferably Labat's type) is withdrawn to prevent injection into a vessel and then the injection is made. The needle is inserted a further centimetre and more lignocaine injected following withdrawal of the plunger to test for intravasation. A total of 10 c.c. of 1 per cent. lignocaine is used.

The process is repeated on the opposite side.



FIG. 191.—SHOWING THE METHOD BY WHICH THE INDEX FINGER OF THE LEFT HAND IN THE VAGINA IS USED TO DIRECT THE POINT OF THE NEEDLE TO ITS CORRECT POSITION IN RELATION TO THE ISCHIAL SPINE.

Pudendal block is usually combined with local infiltration of the vulva, a weal being raised at the fourchette and 0.5 per cent. lignocaine infiltrated freely here and on each side extending well forward in both labia majora. If the local infiltration is carried out before the pudendal block it will reduce the discomfort of the manipulations required for the block itself.

The anaesthetic will take effect within 3 minutes. All vaginal manoeuvres must be carried out with great gentleness. If used for forceps delivery the patient often experiences discomfort when the blades are applied. If she is encouraged to bear down whilst traction is made on the forceps it will often reduce discomfort considerably.

If the block is put in too soon in a breech delivery it may stop the patient's urge to bear down.

Cæsarean section can be performed under local infiltration of the abdominal wall and this is favoured by some authorities.

The problems of general anaesthesia for operative delivery are more fully discussed in special text-books to which reference should be made.

CHAPTER XL

OBSTETRIC OPERATIONS

DELIVERY BY THE FORCEPS

THE original obstetric forceps was invented by one of the two elder Chamberlen brothers who came of a Huegenot family settled in England about the year 1600. The invention was kept secret in the Chamberlen family for over 100 years and passed from the third Chamberlen brother, Peter, down to his grandson Hugh with whom it remained and perished when he died in 1728. For nearly another hundred years, until 1818, the forceps with the rest of the Chamberlen instruments lay hidden beneath the floorboards of a box-room in Woodham Mortimer Hall, Essex, which had been the Chamberlens' home for eighty years.

The Chamberlen forceps were only slightly modified during the hundred years of their secret existence and consisted of two blades, curved to fit the foetal head, joining two short handles, the two halves being strapped together where they crossed because they had no lock. Not long after their re-discovery, Chapman improved the forceps by introducing the shank between the blades and handles and thereby lengthening the instrument. In 1744 William Smellie devised the double slotted English lock which allowed easy, accurate application and at the same time gave additional strength.

The next step forward was in 1747 when the pelvic curve was introduced by Levret of Paris.

The long curved forceps had now arrived but James Young Simpson made important improvements in 1848. He increased the length of the shanks which were made parallel to beyond the lock (to prevent injuring the vaginal introitus during traction) and increased the size of the blades and their curve. Simpson advised a pelvic application of the forceps when the head was oblique in the pelvis because he said there was more room and injury to the mother less likely. This is now known to be wrong; the blades should be accurately applied to the head. In 1877 axis traction rods were added by Tarnier to improve the mechanics of traction in the high forceps operation; Milne Murray's modification appeared in 1895. The long curved and axis traction forceps are those in use today, but in addition there are Kielland's forceps introduced by Christian Kielland in 1915. Their purpose is not only traction, but also rotation of the head. Although they were devised so long ago, it

has only been in comparatively recent years that their value has been appreciated and their use at all common.

Finally light short curved forceps were introduced by Wrigley in 1935 their particular purpose being the low or outlet forceps operation.

This description of the evolution of the forceps has strictly kept only to the important advances and makes no mention of the other very numerous types of forceps, differing in variable degree, in use to-day.

The Object of Forceps.—The forceps is used to apply traction to the head of the foetus in a pelvis the measurements of which are adequate. When Kielland's forceps is used the head may first be rotated into a more favourable position before traction is applied.

Presentations Suitable for Forceps Delivery.—The forceps should be applied only to the head of the foetus. They are designed to fit the head ; if applied to the breech they are liable to slip with resulting injury to the foetus and maternal soft parts.

The presentations suitable for the forceps operation are vertex, face with mento-anterior and the after-coming head of the breech. The vertex may be occiput anterior or posterior, but when the latter, certain additional factors, referred to later, must be taken into account.

Indications for the Use of the Forceps

In considering the use of the forceps the purpose of the operation must be closely studied. There should always be a clear indication that good will come from their use and that the instrument is not merely being used for convenience to expedite delivery in a normal labour. The aim always should be to give *assistance* when it is needed and whilst the circumstances vary considerably the particular indication in almost every case will be found to be one or more of the following, delayed second stage, impending or established maternal distress, impending or established foetal distress. Occasionally aid may be indicated because the second stage contractions are beginning to wane—a sign of impending uterine exhaustion. It is important that a careful abdominal and vaginal examination should be made before applying forceps ; usually under anæsthesia. The bladder must be emptied by catheter. Preparations for proceeding straightway to forceps delivery should have been made, but the importance of a thorough vaginal examination under anæsthesia cannot be too forcibly stressed, in order that the blades may be applied accurately and safely to the head.

Delay in the Second Stage of Labour.—The duration of the second stage varies with the efficiency of uterine action, and with the resistance to descent of the head. In primiparæ it lasts between 1 and 2 hours ; but in multiparæ it is very much shorter, usually being less than half an hour. A second stage, therefore, is commonly considered to be delayed if the limits mentioned are exceeded ; but this definition is only a guide, it must not be too rigidly observed. Because the duration of labour depends on the strength of contractions, delay can be said to occur when progress is not in keeping with such contractions. If the contractions are normal the second stage is of normal duration ; if it is longer labour is delayed. With very strong contractions delay is obvious much earlier. On the other hand when the contractions have been weak throughout labour, progress may be expected to be slower than normal and concern need not be felt if the presenting part is advancing and the patient and fœtus are not distressed. This is not to say that conservatism should be pushed to the limits of human endurance.

Conditions likely to cause delay in the second stage

- i. Inadequate uterine contractions.
- ii. Rigid pelvic floor.
- iii. Rigid perineum.
- iv. Large fœtus.
- v. Minor outlet contraction.
- vi. Persistent occipito-posterior.
- vii. Deep transverse arrest.
- viii. Persistent mento-posterior.
- ix. Constriction ring.
- x. Extended after-coming head.

A common cause of delay in the second stage in first labours is the resistance of the pelvic floor but it should be treated by episiotomy rather than by the application of the forceps. A minor degree of contraction at the outlet has a similar effect in delaying the second stage of labour.

A minor degree of contraction at the outlet has a similar effect in delaying the second stage.

Persistent occipito-posterior, when it has passed the obstetric outlet, often has the same effect because the wide bi-parietal diameter, now too far back, over-distends the perineum ; in fact there is commonly so much rectal pressure that it looks as though the head is trying to be born *per anum*. If the head descends so low as this an extensive periniotomy is usually all that is needed but forceps may be required above this level.

The conditions so far mentioned cause delay at or below the pelvic outlet and call for the low or outlet forceps operation for which the short curved forceps is admirably suited. The second stage may fail to progress because the head is delayed in the pelvic cavity. At this level nothing of the head would be seen when the patient bears down, nor would the perineum have begun to distend. The plane in which the head is most commonly arrested is just above that which marks the junction of the cavity with the obstetric outlet, namely the narrow pelvic plane at the level of the ischial spines.

The conditions which may delay a head at this level are deep transverse arrest and persistent occipito-posterior position; less commonly a face presentation with the chin posterior and obstetric outlet contraction. It is here too that arrest would occur when a constriction ring below the shoulders is present.

In order to diagnose the cause of delay in the pelvic cavity a careful examination should be made under anæsthesia, so that the whole hand can be used inside the vagina.

To apply forceps to the head when it occupies the pelvic cavity constitutes the mid-forceps operation. When the head is just above the level of the ischial spines it is called "low mid-cavity" forceps and usually the long curved forceps, or Kielland's forceps, are used. With the head higher than this (but still within the cavity) as after manual rotation it is spoken of as "high mid-cavity" forceps delivery. Again long curved forceps, or Kielland's forceps, would be used but at this level some authorities employ the axis traction forceps, believing that by their use traction is more in line with the axis of the upper cavity. Thus traction force applied is the minimal required to effect delivery, because none is wasted in dragging the head out of its true path forwards against the back of the symphysis too early in the descent. On the other hand many feel that the same purpose is served by using the much simpler long curved forceps, or Kielland's forceps, in similar circumstances.

Axis traction forceps were originally designed for the high forceps operation with the head above or in the brim. The dangers of this operation make it unjustifiable now that Cæsarean section can be used so much more widely and safely; therefore it has been abandoned.

Maternal Distress.—Once the second stage is reached it is seldom justifiable to allow signs of distress in the patient to appear. When it occurs early it usually means that contractions are strong and arrest has already occurred; when late the safe limits of endurance have been passed. A patient in the second stage needs constant supervision, one of the reasons being to watch for signs of impending distress.

But distress may arise from causes other than purely obstetric, and in certain cases there may be every reason for wishing to avoid even the earliest signs of stress.

In cases of heart disease and pulmonary tuberculosis the forceps should always be applied unless the second stage is progressing smoothly and quickly. In severe pre-eclampsia or eclampsia the stress of expulsive efforts should always be avoided.

When considering whether or not to use forceps under the conditions just mentioned, it is always profitable to compare the relative disadvantages of the effects of anaesthesia with those of a slightly longer second stage with spontaneous delivery. The decision is made much easier nowadays because of pudendal block analgesia and the short light outlet forceps.

Conditions likely to cause maternal distress

- i. Prolonged or delayed labour.
- ii. Pre-eclamptic toxæmia.
- iii. Associated diseases (cardiac, pulmonary).

Signs of Established or Impending Maternal Distress.—These may be broadly divided into mental and physical although the former will always be present in some degree when the latter have appeared. Mental distress occurs in patients who have had a long tedious first stage and are in no condition to co-operate in aiding expulsion during the second stage. If the physical state has been well looked after by way of fluids, glucose and sedatives, the pulse and temperature charts need show no indication of mental fatigue. In some cases the patient is moaning and apathetic; in others restless and unco-operative; there is always some element of confusion. Sometimes a primigravida will be mentally distressed in the second stage even after a normal first stage because she has been frightened and tense throughout. This commonly means that sedatives have been used too sparingly.

The signs of physical distress are a rising pulse-rate and a slightly raised temperature; but this is variable because sweating tends to control it. The blood-pressure always rises a little even in a normal second stage. But apart from the pulse chart the most striking signs are those of the patient's appearance. If labour has merely been long she will look tired and say so, but if distress has arisen as a result of obstructed labour, the contractions are strong and the patient has an air of restless anxiety. Abdominal and vaginal examination will show the signs already mentioned in Chapter XXVIII.

Impending distress means either that progress is not being made in spite of strong pains or that an associated condition, such as heart

disease, is present ; in such cases distress can be anticipated if delivery does not soon take place.

Fœtal Distress.—Presentation and prolapse of the umbilical cord are mentioned first because the threat to the fœtus is so serious and emergency measures needed so urgently. The subject is dealt with in Chapter XXXI but under suitable conditions expeditious forceps delivery may be needed.

Signs that all is not well with the fœtus may develop in any labour but may be expected in particular circumstances. Anything that interferes with fœtal oxygenation will bring it about and if it happens with sufficient intensity in pregnancy the fœtus will die *in utero*. Such conditions as placental infarction and accidental hæmorrhage come to mind readily as complications of pre-eclamptic toxæmia. Diminished utero-placental blood flow can occur in lesser degree in toxæmia and in postmaturity but may not reveal itself until after the onset of labour. Cord compression through tightening of a true knot or loops round the neck would seriously interfere with oxygenation.

Labour itself, if long enough, can cause anoxia especially after the membranes have ruptured. This comes about in two ways. First, the contracting and retracting uterus cuts down the blood-flow in the placenta ; and, secondly, prolonged compression of the head reduces the blood-flow in the brain causing anoxia of the vital centres.

Signs of Established or Impending Fœtal Distress.—Clinically evidence of fœtal distress is shown by changes in the fœtal heart-rate and rhythm and by the appearance of meconium in the escaping liquor. Occasionally convulsive fœtal movements may occur but this is a late sign and heralds disaster.

Conditions likely to cause fœtal distress

- i. Cord complications (prolapse, tight loop or knot).
- ii. Placental insufficiency (toxæmia, hæmorrhage, post-maturity).
- iii. Prolonged or difficult labour.
- iv. Uterine infection.

Normally the fœtal heart-rate slows a little during uterine contractions but recovers fully and quickly in the intervals and the rhythm remains regular. When fœtal asphyxia is developing, leading to signs of distress, the fœtal heart-rate not only slows more during contractions, but its recovery is slow and as the condition develops the rate drops lower still and the beat becomes feeble and irregular. A fœtal heart-rate persistently below 100 beats a minute arbitrarily

constitutes foetal distress. Occasionally the first sign may be an increased heart-rate to an almost uncountable speed and sometimes it will fail suddenly, but more usually there is a gradual slowing before it stops. Congenital heart block caused by fibro-elastosis interrupting the auriculo-ventricular bundle is a rare cause of a slow foetal heart rate. The condition may be recognized in three ways; by noting that the slow rate has always been present (even in pregnancy); by observing that the slow rate does not vary in labour; and if possible having a foetal electro-cardiogram done when the characteristic changes of atrio-ventricular dissociation will be seen. The prognosis for the infant is not good.

Finally an increase in the foetal heart-rate can be brought about by intra-uterine infection and in these circumstances the patient's temperature is raised. Antibiotic therapy after taking a high vaginal swab and urgent delivery, even by Cæsarean section, are indicated.

The sudden appearance of meconium in the liquor amnii is also a sign of foetal distress. It is due to agonal peristaltic movements in impending asphyxia. The appearance of meconium-stained liquor can be misleading, for if it is seen as the membranes rupture distress has taken place at some time, but has not necessarily persisted; counting the foetal heart-rate will decide this point. Further, stale meconium stains the liquor a greyish pale green colour, whereas when it is fresh it is a much darker green. Thick meconium sometimes drains from the vagina in breech presentation; it usually results from compression of the foetal abdomen in the pelvis, though it could, of course, arise from impending asphyxia in breech labour.

When there are clear-cut signs of foetal distress in the second stage of labour there should be no hesitation in assisting delivery. The conditions governing the application of the obstetric forceps should be fulfilled and whilst final preparations for the delivery are made oxygen should be given to the patient in the hope of improving the state of the foetus. When the indication for forceps delivery is foetal distress, even greater care than usual should be taken to avoid cyanosis, by manipulating the head into the optimal position, by applying the forceps accurately to the head and in effecting delivery with care, but without needless delay. An adequate perineotomy reduces the risk of adding intra-cranial stress to the clinical picture.

Needless to say, full preparations should have been made for resuscitation of the baby. It will almost certainly have inhaled meconium contaminated liquor, possibly infected, through paralysis the respiratory centre by asphyxia. The management of asphyxia neonatorum is dealt with in Chapter XLVII.

Conditions which must be Fulfilled Before Application of Forceps.—To apply forceps safely and successfully certain basic conditions must be fulfilled. To ignore them invites needless complications.

- i. The presentation must be suitable.
- ii. The head must be engaged.
- iii. The pelvic outlet must be adequate.
- iv. The cervix must be fully dilated.
- v. The membranes must be ruptured.
- vi. The bladder and rectum must be empty.
- vii. The uterus must be contracting and relaxing.

In the first place, *the presentation must be suitable*. The forceps can only be applied to the head of the fœtus and then only when it presents either as a vertex or as a face with the chin anteriorly placed: the after-coming head of a breech is commonly delivered by forceps. The forceps must be applied accurately to the fœtal head in the manner to be described later: otherwise dangerous compression of the skull will arise causing intra-cranial stress and hæmorrhage and very likely too the attempt to deliver will fail. If the forceps slip off during traction as they are likely to do when applied with the occiput posterior a complete tear of the perineum may be the result. Although it is permissible in certain circumstances to deliver an unrotated persistent occipito-posterior presentation with the forceps, the blades of the forceps should preferably be applied to the sides of the head with their concavity facing towards the occiput. This is not possible when the occiput has not rotated.

The head must be engaged.—If the head is not engaged in the second stage of labour disproportion is present: either apparent because of extension of the head, or real from pelvic contraction. The use of forceps in such circumstances would constitute a high forceps operation, which, on account of the dangers to both fœtus and patient, must never be considered.

Even with the head engaged *the pelvic outlet must be of adequate dimensions* so that there is no serious bar to the passage of the head. If the subpubic angle is narrowed there must be adequate room in the posterior sagittal diameter.

The cervix must be fully dilated.—If it is not, in the first place there will be difficulty in applying the forceps without including and tearing the cervix. Moreover a much greater traction force is needed to overcome the resistance of the cervix and this will be transmitted to the fœtal skull, often with serious consequences. Finally the attempt to deliver will probably fail. In the hands of an experienced operator

forceps may be applied when the cervix is nearly fully dilated, but it is only in order to steady the head while the cervix is carefully pushed up above it, before traction is applied.

It is usually said *the membranes must be ruptured* before forceps can be applied safely. The danger is said to be detachment of the placenta. This is probably largely theoretical, but intact membranes could make the application of the forceps difficult. In any case there is seldom any indication to apply forceps before the membranes rupture and if there is it is a simple matter to rupture them before doing so.

The bladder and rectum should be empty. A catheter is passed to empty the bladder always as a preliminary to forceps delivery not only in order to avoid injuring it but also to remove its inhibiting influence on retraction of the uterus after delivery and in this way cause post-partum hæmorrhage. The rectum is emptied routinely by enema at the beginning of labour. A rectum full of firm fæces could be damaged during forceps delivery; and expulsion of the fæces is of course undesirable.

The uterus should be contracting and relaxing.—Only very rarely would uterine exhaustion be so pronounced as to result in complete inactivity. If it has and there is an indication to expedite delivery before the contractions have returned spontaneously, oxytocin may be given by continuous intravenous infusion and then delivery by forceps. Again a uterus so unrelaxed (in other words, in a state of tonic contraction) as to offer serious resistance to delivery would be seen even more rarely. The treatment of the condition is dealt with in Chapter XXVII.

The Dangers of Forceps Delivery

Some of the dangers inherent in forceps delivery are due to the circumstances leading up to the need for the operation rather than to the operation itself. For example, delivery by forceps is very commonly called for at the end of a long tedious first stage of labour because of either maternal or foetal distress or both. In these circumstances nearly all the hazards related to forceps delivery occur and the dangers can be decreased only by taking the following proper measures to reduce them.

An experienced and skilful anæsthetist will ensure the stomach is empty, that the table tilts down by the head efficiently and that a suction apparatus is available before he begins the anæsthetic. In this way one of the greatest dangers today, obstetric anæsthesia, in assisted delivery is greatly reduced. The anæsthetic agent chosen must be suitable to the operation, producing satisfactory relaxation for such

manœuvres as rotation of the posterior occiput ; the degree of anæsthesia need only be light for a simple low forceps operation. A significant proportion of the difficulty of an obstetric manœuvre can be reduced by adequate relaxation and the risk of the operation thereby decreased. But too much anæsthetic (especially if it is ether) and therefore too much relaxation may produce a toneless uterus in and after the third stage with resulting retention of the placenta, or postpartum hæmorrhage, or both. For this reason the amount of anæsthetic should be reduced as soon as the child is delivered. The effect of the anæsthetic agent on the foetal respiratory centre should not be overlooked and provides another good reason for curtailing general anæsthesia as soon as practicable.

When the first stage has been long there is usually a well marked caput succedaneum and this obscures landmarks on the foetal head by which the position of the occiput is determined. Moreover, in just such a labour the occiput is often posterior. As the sutures and fontanelles are often obscured the ear is the best guide to the position of the head. The membranes have usually ruptured early allowing most of the liquor to escape ; this makes rotation more difficult and increases the risk of infection. Finally, characteristically in this type of labour the foetus is often rather large and the pelvis android in shape with reduction in the size of the outlet. These features increase the risk of vaginal and perineal laceration and of foetal intra-cranial stress, facial palsy, cephalhæmatoma and trauma to the brachial plexus.

Both judgment and skill are exceptionally important in dealing successfully with the above conditions.

There is no need to look any further for dangers resulting from forceps delivery than those mentioned in regard to the case of prolonged labour. They are all *immediate* complications and may be summarized as follows :

IMMEDIATE: *Mother:*

Dangers of anæsthesia

Lacerations of cervix
vagina
perineum

Postpartum hæmorrhage : Anæsthesia
Uterine fatigue
Lacerations

Puerperal genital infection

Infant:

Intracranial stress
Facial palsy
Cephalhæmatoma
Brachial plexus trauma

DELAYED:*Mother:*

Chronic low back strain
Prolapse
Cervical leucorrhœa
Introital dyspareunia

Infant:

Spastic palsy
Brachial plexus palsy

The delayed effects of complicated forceps delivery need further discussion.

Chronic low back strain of obstetric origin ordinarily results from a failure in involution of the lumbo-sacral, sacro-iliac regional pregnancy changes. A forceps operation with the patient relaxed under anæsthesia in a well-flexed lithotomy position often adds greatly to the tension imposed on the softened ligaments guarding these joints. Little wonder, therefore, that low backache is not uncommon. Prolapse may result from a forceps delivery ; it is especially likely when the head is dragged through a cervix which is not fully dilated. Vaginal prolapse may be due to unskilful forceps delivery particularly if the levator shelf is torn or overstretched by extracting the head in malposition ; or it may be due to an unskilfully repaired extensive perineal wound.

By cervical leucorrhœa is meant the production by the cervix of an excessive amount of mucus. When this follows delivery it is usually due to ectropion of the cervix resulting from bilateral laceration. Such an injury may have been produced by forceps applied either outside a residual rim of cervix or more likely by dragging a head forcibly through it.

Introital dyspareunia following delivery may be due to the unprecise suturing of episiotomy or perineal laceration resulting in an introitus which is too narrow. It may result too from a tender scar following poor healing due to infection.

Spastic palsy is usually the result of either unskilful assisted delivery or an error of judgment on the part of the operator and is due to cerebral injury usually from over-compression. It can, of course, occur after spontaneous delivery.

Brachial plexus injury may be caused by the unskilful use of forceps but it usually results from difficulty in delivering the shoulders either because of pelvic contraction, or an over-sized baby, or both.

Bad results from forceps delivery usually result from bad forceps delivery. The dangers will be minimal only when proper regard is given to the indications for the operation and when the exact position of the head is determined by a preliminary vaginal examination and any

necessary correction made before the forceps is applied and traction made. Good anæsthesia and basic obstetric skill are no longer exceptional refinements, but are the essentials on which safe forceps delivery must depend.

Types of Obstetric Forceps

Although the obstetric forceps in use today are many and varied, those in each class differ usually only in minor details. In the main forceps can be classified as follows :—

1. Short curved forceps.
2. Long curved forceps.
3. Kielland's forceps.
4. Axis-traction forceps.

The basic construction of all modern forceps is the same in that the instrument consists of two halves meeting at the lock. Each half has a fenestrated blade which is joined to the handle by a shank. The blades have two curves ; the cephalic curve in which the blade is curved to correspond with that of the foetal head ; and a curve on the edge, the pelvic curve, to correspond with that of the pelvis and to grip the head more centrally. The length of the handles and the shanks varies with the different forceps and the type of handle is variable too. Kielland's and axis-traction forceps have special characteristics of their own.

Short Curved Forceps.—This instrument designed by Wrigley in 1935 is for use in the low or outlet forceps operation. It could be called a miniature long curved forceps but it differs in having much shorter shanks (1 inch instead of $2\frac{1}{2}$ inches) and handles, and in being a much lighter and more delicate instrument.

Long Curved Forceps.—Although the long curved forceps can be applied to the head which has passed only partly through the brim of the pelvis, this should never be attempted. The pelvic curve enables the instrument to be applied to the head correctly at any pelvic plane. The total length of this instrument is 15 inches and it is relatively heavily built.

Kielland's Forceps.—The chief advantage of this instrument is that it allows accurate cephalic application, no matter what the position or level of the head in the pelvis. If the occiput is posterior, or in a position of transverse arrest, application is made first and next the head slightly elevated and then gently and precisely rotated bringing the occiput anterior.

Each blade consists of a handle, shoulder (proximal and distal), shank and blade. One characteristic feature is the lock which allows one blade to slide on the other in the long axis and in this way permits the blades to lie at different levels when applied to a head which is lying transversely. When rotation is made as the sides of the head gradually move into the same horizontal plane with the occiput coming to the front, so do the blades applied to them by virtue of the sliding action allowed by the lock.

The other characteristic is the pelvic curve. This is initially in a backward direction and then it quickly begins its forward sweep but the tips of the blades never quite reach the plane of the shanks and handles. It is this feature which makes rotation by forceps possible; and in experienced hands it is safe and reliable as well.

Axis-traction Forceps.—To enable the operator to exert traction in the best possible direction, the axis traction forceps was invented.

There are two patterns in common use:

- (a) *The Milne Murray Axis-traction Forceps.*
- (b) *The Neville-Barnes Axis-traction Forceps.*

(a) **The Milne Murray Axis-traction Forceps.**—Each half of the instrument consists of six parts, the blade, shank, lock, handle, fixation-screw, traction-rod, and the seventh part, the traction-handle, is common to both halves.

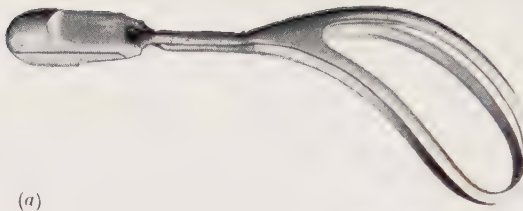
Blade. The blade, which is fenestrated, has two curves, one on the flat, the cranial curve, and the other on the edge, the pelvic curve. The shape and size of the curve is the same in both, *i.e.* it forms part of a circle whose radius is 18.75 cm. (7 inches). When the blades of the forceps are locked the distance between their inner surfaces at the widest point should be 8.4 cm. ($3\frac{3}{8}$ inches), and between their tips it should be 3.75 cm. ($1\frac{1}{2}$ inches).

Shank. The shank, that part of the instrument between the lock and the blade, should be 6.25 cm. ($2\frac{1}{2}$ inches long).

Lock. The best type of lock is that known as the English lock.

Application Handle. The handle should be 5 inches long (12.5 cm.), and, so that it can be grasped without slipping, it should have large ribs on its outer surface, since if the instrument is being used in a case in which the head is low down on the perineum the delivery of the head can be more effectively controlled by making traction with the handles than with the traction-rods.

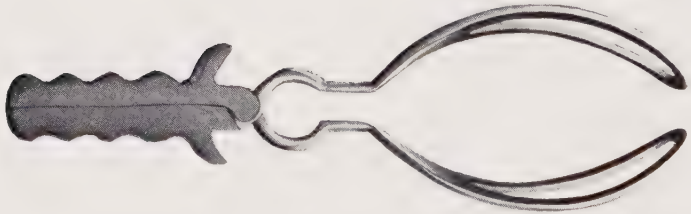
Fixation-screw. The fixation-screw is attached by a swivel to the handle of the left or lower blade, and fits into a slot in the handle of the right or upper blade. To prevent the blades being separated



(a)



(b)



(c)



FIG. 192.

(a) Short Curved (Wrigley's) Forceps.

(b) Long Curved Forceps

(c) Kielland's Forceps

when traction is made with the traction handle, the screw is tightened during traction.

Axis-traction rod. To each blade is attached an axis-traction rod, the upper end of which fits into a slot in the lower part of the fenestrum of the blade. The rod is so fashioned that it lies in contact with the shank as far as the lock and then curves backwards away from the handle.

Traction-handle. This is attached to the traction-rods after the forceps is in position and contains a ball and socket joint. (Fig. 193.)

The chief disadvantage of the axis-traction forceps is that it is more difficult to apply owing to the number of parts of which it is composed; this type of forceps is used much less often than formerly when the forceps was frequently applied to the head when high. Its advantages are that, if used when the head is high, traction can be made in the correct axis of the pelvis because the lower part of the traction-rods is curved backwards over the perineum and the ball and socket joint of the traction-handle allows the head to rotate during traction.

(b) **The Neville-Barnes Forceps** achieves axis traction almost as efficiently but is very much easier to use because the axis tractor is completely outside the vulva when applied. (See Fig. 194.)

The increased efficiency of antenatal supervision in the detection of disproportion between the presenting head and the pelvic brim, and the diminished risk of Cæsarean section have almost abolished the need for the application of the forceps to the head at a level higher than the mid-pelvic cavity. Indeed, in many cases in which assistance is needed, the birth of the foetal head is delayed only by the pelvic floor muscles. The long curved forceps, with or without any axis traction apparatus, is an unnecessarily heavy, powerful and potentially dangerous instrument for the low forceps operation. The correct instrument for this operation is the short curved forceps.

Action of the Obstetric Forceps.—The obstetric forceps should be used only as a tractor except Kielland's forceps.

If it is thought that forceps delivery may be indicated a full examination, including a vaginal examination, should be made on the

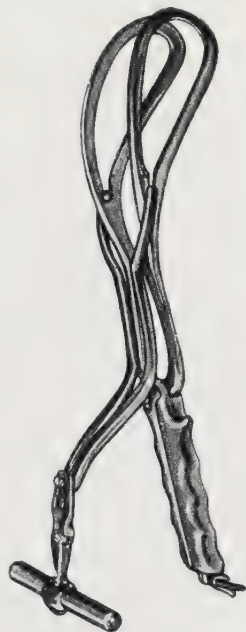


FIG. 193.—MILNE MURRAY
AXIS-TRACTION FORCEPS.

conscious patient to ensure that conditions are suitable for a safe forceps delivery.

The operation of forceps-delivery is divided into three parts :—

1. The preparation necessary for the application of the forceps.
2. The application of the forceps.
3. The extraction by the forceps.



FIG. 194.—NEVILLE-BARNES FORCEPS.

The Preparation Necessary for the Application of Obstetric Forceps

(a) The instruments are prepared as for any other operation.

(b) The vulva having been shaved is thoroughly washed with soap and water and finally swabbed with a suitable antiseptic. The operation field is surrounded by sterile towels.

(c) Some form of analgesia should be provided. This may take the form of pudendal block, caudal or extra-dural analgesia or general anaesthesia. Whatever form is used it is the wisest possible precaution to have a medical colleague sitting by the patient's head. It is essential that a general anaesthetic be given by one experienced in dealing with the particular complications which may arise. Unless it is reasonably certain that the patient's stomach is empty a stomach tube must be passed before the anaesthetic is begun. It is essential that the head of the table can be lowered without delay in case of unexpected gastric regurgitation.

Finally, a third person, experienced in the resuscitation of the asphyxiated newly born infant, should be present.

(d) The position of the patient on the delivery table varies. In England in domiciliary practice the left lateral position is often favoured, but in hospital the lithotomy position is generally used. The reason for this is that in difficult or complicated delivery the latter is preferable. One advantage of the left lateral position is that aspiration of regurgitated stomach contents is not so likely to happen as when the patient lies on her back.

(e) The bladder is emptied by catheter.

(f) The preliminary vaginal examination. With the patient anæsthetized and in position, the fingers of the gloved hand lubricated with antiseptic are introduced into the vagina. This will discover how low the head is if it is not already visible and will often determine fully the whole situation, if the head is low and the fontanelles and sutures unobscured by caput formation. If the information gained is insufficient then the whole hand must be introduced, but the perineum may need to be ironed out with the fingers or even incised, especially when the patient is a primigravida. The first aim always is to confirm that the cervix is fully dilated, then to determine the presentation and position by feeling the whereabouts of the fontanelles and sutures. If a caput obscures them, an ear must be felt and the direction in which the pinna is pointing shows where the occiput lies. The presence or absence of excessive moulding of the head and its mobility will be noted and finally whether or not the obstetric outlet seems big enough to allow the head to pass. Assessment of pelvic size is by no means always easy, and only comes with experience, but the points to seek are the prominence of the ischial spines, the width of the subpubic arch and the length of the sagittal diameter of the obstetric outlet from the lower border of the symphysis pubis to the sacrococcygeal joint. When all these items have been checked and found satisfactory, there still remains the position of the head. If the occiput is in the mid-line in front, the forceps can now be applied, but if it is lying obliquely or transversely, manual rotation will be needed first, unless, of course, Kielland's forceps are being used, when the head may be rotated with the forceps. If the occiput is posterior, unless the head is so low that the perineum is being stretched, or unless the pelvis is the transversely narrowed anthropoid type, it is almost always better to rotate the occiput to the front before the head is delivered. The disadvantage of not doing so is the increased risk of intra-cranial stress which goes, naturally with malposition of the vertex.

If the head has not descended to the pelvic floor then a more serious cause for delay is likely. A flattening or even protrusion forwards of the sacrum might be felt confirming pelvic contraction, or the head found to be severely deflexed or extended. Any serious doubt about

the size of the pelvis with the head arrested at this level would almost certainly make Cæsarean section the safer form of delivery. When there is malposition only it would be corrected and mid-pelvic forceps delivery then carried out.

The Application of Obstetric Forceps

(a) *With the patient in the left lateral position* the left or lower blade is introduced first, otherwise the handles will not lock. The fingers of the left hand are passed into the vagina, their palmar surface upwards, and feel their way up beside the head. The handle of the left or lower blade is now taken lightly between the fingers and thumb of the right hand and the tip of the blade,  concave surface upwards, is gently slid



FIG. 195.—APPLICATION OF THE LEFT OR LOWER BLADE OR THE FORCEPS FIRST.

The fingers of the left hand, palmar surface upwards, have been introduced into the vagina. Sterile towels have been omitted for the sake of clearness.

between the guiding fingers of the left hand and the side of the head where it comes to rest. If this half of the instrument is in the correct position, the lower blade should be lying against the left side of the pelvis, the shank should be in contact with the perineum, and the outer or roughened surface of the handle should be directed upwards.

The left hand is now held with its palmar surface downwards, the fingers again being inserted between the head of the child and the tissues of the mother. The operator then holding the handle of the upper blade lightly in his right hand with its end lowered and pointing forwards, passes the upper blade gently between the guiding fingers of the left hand and the side of the head to which it is applied. If this half of the instrument is in its correct position, the upper blade

should be lying against the right side of the pelvis the upper handle should be in contact with the lower handle, and its outer or rough surface should be directed downwards.



FIG. 196.—APPLICATION OF THE RIGHT OR UPPER BLADE OF THE FORCEPS.

The fingers of the left hand, palmar surface downwards, have been introduced into the vagina. Sterile towels have been omitted for the sake of clearness.

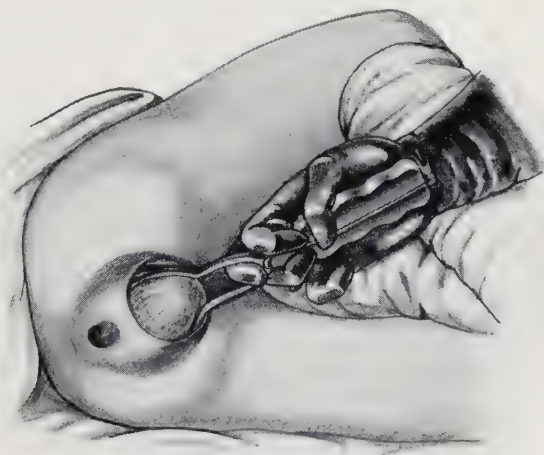


FIG. 197.—DELIVERY IN THE LEFT LATERAL POSITION BY THE FORCEPS.

Towels have been omitted for the sake of clearness.

The handles can then be locked without any trouble ; a further examination should be made to ensure that only the head of the child is grasped by the forceps.

Occasionally difficulty may be experienced in locking the forceps. This may be due to relatively trivial faults such as to the fact that both blades have not been passed the same distance or that one blade has rotated after its introduction. A more serious cause, however, and one which should always be borne in mind, is that the exact position of the foetal head has been diagnosed incorrectly and that the instrument has been applied to a foetal skull which is in the oblique or transverse diameter of the pelvis. If therefore the forceps do not lock or the handles do not close together the correct procedure is to remove the



FIG. 198.—INTRODUCTION OF THE FORCEPS IN THE LITHOTOMY POSITION.
STAGE 1.

instrument completely and to re-examine the position of the foetal skull. This may have to be repeated more than once until an accurate application is made.

(b) *With the Patient in the Lithotomy Position.*—The left blade of the forceps is applied first. The fingers of the gloved right hand are passed into the vagina. The left blade of the forceps is then held between fingers and thumb of the left hand by its handle, and passed between the foetal head and the palmar surfaces of the fingers of the right hand, thus protecting the birth-canal from injury. The handle is held well over the mother's abdomen, and inclined to the mother's right side, so that it is almost parallel with her right inguinal ligament. As the blade passes up into the birth-canal the handle is carried backwards and

towards the mid-line, thus following the direction of both the pelvic and the cephalic curves.

The fingers of the right hand are now withdrawn after ascertaining that the blade lies next to the head and in accurate position.

The fingers of the left hand are now introduced along the right side of the mother's pelvis, and the right blade of the forceps is held as before and passed in a similar manner. Its external visible portion will thus lie above and across the handle of the left blade. The two blades are now locked and are ready for traction to be applied. At first the



FIG. 199.—INTRODUCTION OF THE FORCEPS IN THE LITHOTOMY POSITION.
STAGE 2.

direction of the pull will be downwards and backwards towards the anus, but as the head advances it will be made in a downward and forward direction in order to follow the curve of the pelvis.

Forceful extraction should not be used. When the head is crowned, the blades should be unlocked and removed gently and separately.

Application of the Forceps to the Face.—If the head is delayed in the pelvic cavity and the chin is pointing forwards, and there is no contra-indication to its use, the forceps may be used to assist delivery of the child. The method of application is the same as that already described, but the handles should be kept well forward in order to avoid the blades grasping the neck. If the chin is pointing backwards, the face should be rotated manually and the

forceps then applied. When the head is large and does not rotate or cannot be rotated, labour is obstructed and should be dealt with as described in Chapter XXVIII.

Application of the Forceps to the After-coming Head.—In some units the forceps is applied to the after-coming head in breech delivery as a standard procedure : in others only when there is delay with the head

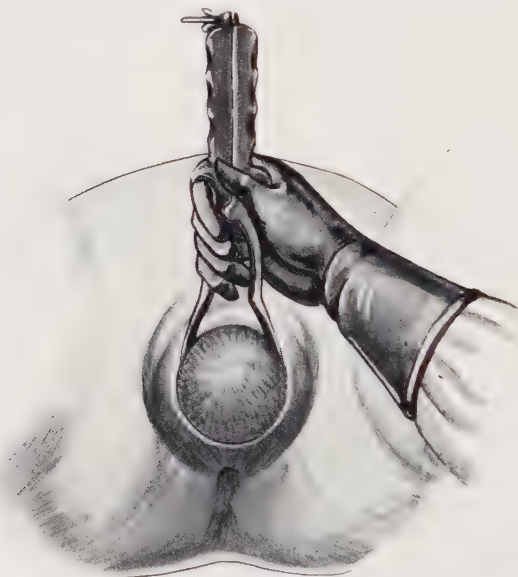


FIG. 200.—LITHOTOMY POSITION. STAGE 3.

in the pelvic cavity or on the perineum. Before the forceps is applied, the body of the child must be drawn forward if the occiput is in front, and when the instrument is applied its handles will be as shown in Fig. 131, page 338.

Relation of the Blades of the Forceps to the Head of the Child.—When applying the forceps by the method described, the blades have been passed so that they lie in relation with the sides of the mother's pelvis without any particular regard to the position of the head of the child. So far as the head of the child is concerned the proper diameter to be grasped is the bi-parietal. In the majority of cases in which delivery by the forceps is necessary this is the diameter that is grasped, since the forceps is most often used after the long diameter has rotated into the antero-posterior diameter of the cavity (Fig. 201). If the head is lying diagonally, an oblique diameter stretching between a point a little in front of one parietal

eminence to a little behind the other will be the part of the head between the blades of the forceps and it will not be grasped so securely as it should be, and as a result, not only may the forceps slip when traction is applied and probably lacerate the vaginal walls, but also the head being gripped, will be prevented from rotating into the roomier antero-posterior diameter and being dragged forcibly through an unfavourable



FIG. 201.—POSITION OF THE BLADES OF THE FORCEPS DURING EXTRACTION OF A FIRST VERTEX.

The blades of the forceps lie in the submento-vertical diameter and grasp the bi-parietal diameter.

one. Hence if manual rotation has not brought the occiput fully forward and if the head is lying obliquely, it is better to apply the blades of the forceps to the sides of the head rather than to the sides of the pelvis.

When the forceps is applied to the face the blades rest against the sides of the head in a diameter approaching the occipito-mental (Fig. 202). When the forceps is applied to the after-coming head the blades grasp the bi-parietal diameter (Fig. 203).

Extraction by the Forceps.—The handles being held lightly with the fingers of the right hand, the direction of the traction will vary according to the position of the head of the child. This direction, which at first should be as far backwards as possible, is gradually

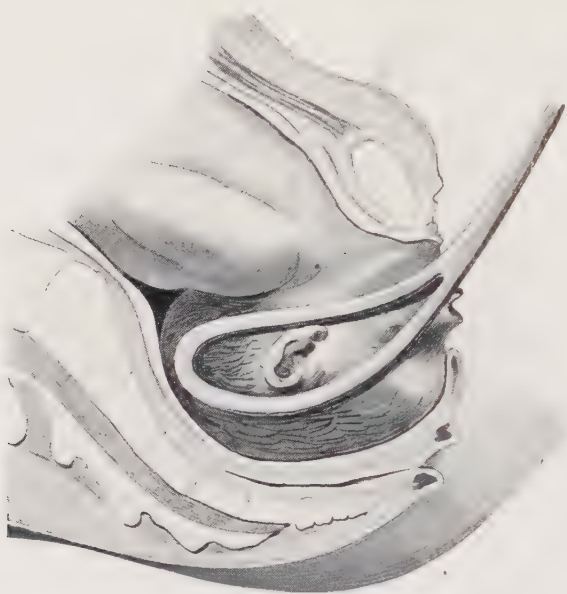


FIG. 202.—POSITION OF THE BLADES OF THE FORCEPS DURING EXTRACTION OF MENTO-ANTERIOR POSITION.

The blades of the forceps lie in the occipito-mental diameter and grasp the head in the bi-zygomatic diameter.

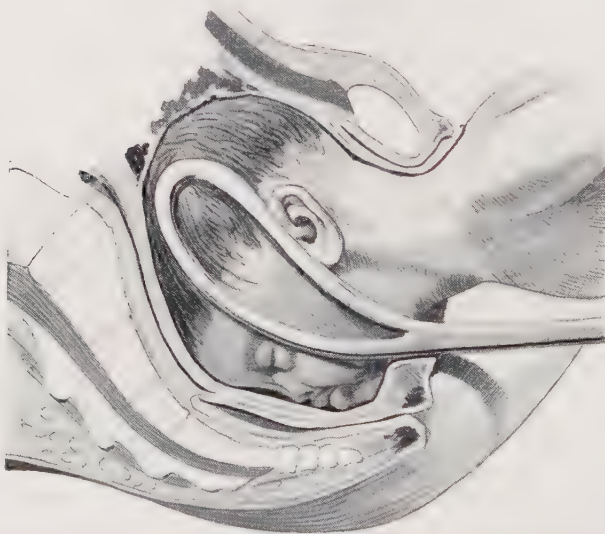


FIG. 203.--POSITION OF THE BLADES OF THE FORCEPS DURING EXTRACTION OF THE AFTER-COMING HEAD.

The blades lie in the submento-vertical diameter and grasp the head in the bi-parietal diameter.

shifted forwards as the head descends until the outlet of the vagina is approached, when it should be forwards. It is better to remove the forceps when the head of the child is crowned, since the danger of rupturing the perineum will thereby be lessened.

Precautions to be taken during the Extraction.

- (a) The direction of the pull must be in the axis of the birth-canal.
- (b) The strength of the pull must be regulated.
- (c) The grip of the forceps must be relaxed between pulls.

The direction of the traction has already been dealt with. When the axis-traction forceps is used very little strength is required in delivering the child. The common practice of using great force if the head is not moving easily is most reprehensible, and is an indication that the operator either is trying to deliver too quickly or has not correctly diagnosed the cause of the delay and should not be using the forceps at all. If the use of the forceps is persisted in, even if the head is finally extracted, the mother runs a great risk of being seriously torn, and the child will almost certainly be dead. Rather more force is required when delivering with the long curved forceps than with axis-traction forceps, but certainly not more than can be exerted with the forearm alone. To deliver as quickly as possible traction should generally be made intermittently and delivery made easier by an episiotomy.

The use of Kielland's Forceps.—In order to use Kielland's forceps safely and successfully, the technique should be thoroughly learned both by meticulously reading the description and by practising using the instrument on the model. Nor is it enough merely to use the forceps on a difficult case; it is preferable to use it regularly whenever mid-cavity forceps is called for in order to become increasingly familiar with it.

Before applying the forceps it is essential to find out the exact position of the head in the pelvis by vaginal examination. When it is lying antero-posteriorly or slightly obliquely correct application of the forceps will not be difficult. But if the head lies transversely the special technique for applying Kielland's forceps is called for. The object, as with any other forceps, is to fit the blades accurately to the sides of the foetal head. There are three methods of application to the head lying in the position of transverse arrest:—

- (i) Classical (Kielland's).
- (ii) Wandering.
- (iii) Direct.

Having completed the preliminary vaginal examination, the exact position of the head in the cavity memorized, the forceps locked together is held before the vulva in the position to be taken up when applied to the head ; one blade will be anterior and the other posterior. Whatever method is used the anterior blade is always applied first ; so the anterior blade is retained in the hand and the other returned to the instrument table. The methods differ only in the application of the anterior blade.

Classical Method.—The anterior blade is taken lightly with the fingers and thumb of the right hand and with its cephalic surface directed forwards, guided by the fingers of the left hand between the head and the symphysis pubis. When the blade of the instrument is entirely above the head it is gently rotated through 180 degrees bringing the cephalic surface into its correct position for the head, which it will now occupy when the blade is slightly withdrawn.

Wandering Method.—The anterior blade is taken as before and is guided into the pelvis *behind* the head, the cephalic surface properly facing the head. It is now slid gently round the pelvis, keeping as close as possible to the head, over the forehead and then comes to rest fitting over the anterior parietal eminence.

Direct Method.—This is used only when the head is low down on the pelvic floor and the fit of the head not too tight. The tip of the anterior blade with the handle as far back as possible is applied to the side of the head anteriorly and gently slipped up over the parietal eminence behind the symphysis, its cephalic surface hugging the head in transit. The posterior blade is introduced behind the head, the fingers of the left hand guiding it into position and keeping it close to the head all the way. If there is difficulty with the posterior blade it may mean that it is not within the rim of the cervix or that there is too little room for safe application and delivery. With the blades satisfactorily applied the handles are locked and it will now become apparent at what different levels the blades are lying for the handles temporarily seem unequal in length.

Rotation of the Head.—Force is never used and rotation is done with three fingers of one hand only. Rotation may be made first at the level of arrest but if not immediately easy the head should be elevated slightly and rotation tried again. Sometimes rotation will be easier after traction has caused the head to descend to a roomier level.

Traction is made in the line of the handles and is exerted by two fingers only hooked over the proximal shoulders of the handles.

Rotation and traction are never done together but one after the other. Sometimes spontaneous rotation takes place during traction and must not be impeded. The handles should never be compressed.

The use of Axis-Traction Forceps.—The special indication for using axis-traction forceps (high forceps seldom exists today). The application is similar to that of the long curved forceps except that with the Milne-Murray type each half has a traction-rod already attached to the blade. When applying the left blade, the traction-rod is held backwards but, when applying the right blade, the traction-rod must be held forwards otherwise it will prevent the blades locking.

When the Neville-Barnes type of forceps is used the blades are first applied and then the traction handle is attached.

Extraction by the Axis-traction Forceps.—The traction-handle is held lightly with the fingers of the right hand, counter-pressure on the towel covering the buttock, if necessary, being made with the left hand.

The direction of the traction will, of course, vary according to the position of the head of the child, and since the blades of the forceps are firmly attached to the head the handles of the forceps will always indicate its position. All the operator has to do when pulling, therefore, is to keep the traction-rods close to the shanks of the forceps. It is better to remove the forceps when the head of the child is crowned, since the danger of rupturing the perineum will thereby be lessened.

To apply traction correctly just before the head is crowned, the operator should drop the traction-handle and take hold of the shanks of the forceps with his right hand, the thumb being directed forwards, and the forceps is now pushed forwards and upwards till the head of the child is crowned or born.

Failed Forceps.

Each maternity unit has amongst its emergency admissions a number of cases classified under this heading. Fortunately the figures to-day are far smaller than they were even 10-15 years ago, for the dangers to mother and baby associated with failed forceps are potentially serious and are directly proportional to the lack of skill and the force employed in the unsuccessful attempts at delivery. For instance, one comparatively recent report showed that 7 per cent. of the mothers died and 43 per cent. of the babies were either stillborn or died soon after birth.

The most common cause is lack of obstetric skill and following on this, poor clinical judgment. How else could forceps be applied repeatedly and strong traction made with the cervix not fully dilated often with the head in malposition? The serious criticism is made not

so much against *attempting* to apply forceps or *attempting* traction, but against *persisting* doggedly in such endeavours in the face of obvious difficulties.

It might be argued that a trial of forceps is sometimes practised now : so it is, but when done it should always be under the ideal conditions of a fully staffed obstetric unit with the necessary skill and operative facilities which such a procedure demands.

The circumstances surrounding failed forceps are mostly commonplace, either the cervix is not fully dilated or the head is in malposition, usually occiput posterior. Attempts to apply forceps with the head not yet engaged fortunately are not often made nowadays, for the dangers are proportionally greater. The actual damage to the patient caused through badly used forceps may be a severe laceration of the cervix when either the blades of the forceps are applied outside it because of incomplete dilatation, or the head forcibly dragged through resulting in a split cervix, possibly extending into the lower uterine segment. Sometimes an extensive tear of the upper vagina is caused when the forceps are roughly forced on to a head lying in a bad position ; or it may result from attempts to rotate the head with ordinary long curved forceps. If the obstruction is at the brim, the uterus itself may have been perforated by a blade of the forceps causing uterine rupture or the bladder or rectum torn. A complete tear of the perineum into the anal canal, not an uncommon accompaniment of failed forceps, comes about from a combination of roughness and misapplied force, both no doubt, due to a final desperate effort to deliver.

The effect on the patient of many of these obstetric insults, even if she has avoided a badly given or prolonged anæsthetic, is to cause shock from the trauma inflicted or the resulting hæmorrhage or both. Sepsis naturally is likely to follow and even nowadays can produce serious consequences. The damage to the foetus is almost always that of intracranial hæmorrhage and it may be dead on admission or die soon after ultimate delivery ; or short of death there may be permanent cerebral damage resulting in spastic palsy.

Cephalhæmatoma and facial palsy are the comparatively minor penalties an unfortunate foetus may have to pay. If only the preliminary vaginal examination were always carried out conscientiously and carefully, the serious damage done in many cases of failed forceps could be entirely avoided.

Pudendal Block Analgesia. This form of analgesia was introduced in order to avoid the use of a general anæsthetic or other more complicated forms of analgesia, when assisted delivery, although indicated, is not expected to be difficult.

It is especially valuable for patients suffering from heart disease or pulmonary tuberculosis when an easy low forceps delivery is being carried out to save the patient from the need to push.

It is also an important part of the technique of modern breech delivery, the infiltration being done when the breech begins to distend the perineum. Pudendal block in producing local analgesia abolishes the perineal reflex, and with it the desire to bear down, and often uterine contractions for a time. It is desirable, therefore, not to produce analgesia too early in breech delivery.

The technique of pudendal block analgesia is described in Chapter XXXIX.

VERSION

Version means turning the foetus and in this way the lie or presentation may be changed. When the head is made to present it is called *cephalic version* and when the breech *podalic version*.

Version can be : External
Internal
Bipolar

External Version.

When the foetus is turned by manipulation which involves using both hands on the patient's abdominal wall, it is known as external version. Nearly always it is the head that is made to present and then it is called external cephalic version. Occasionally this is not possible and so breech presentation is chosen as second best and external podalic version is done.

Indications.—The most common indication for external version is to turn a breech into a head presentation in the antenatal clinic, usually between the 32nd and the 36th weeks of pregnancy, although it can often be done later. Sometimes in cases of hydramnios the foetus will be found lying obliquely or transversely. It would be turned to a head in the last 4 weeks of pregnancy in the hope that it will remain, but even before this it might be gently turned to discover if the head is being kept out of the pelvic brim by placenta praevia. Very occasionally in late pregnancy the breech might be found lying obliquely in the iliac fossa of a multipara with a lax abdominal wall, and it might now be possible to turn the foetus right round to a head presentation. The next best thing would be to turn it by podalic version so that the breech presents.

Contra-indications.— The commonest reason for wishing to avoid external version is when the patient has bled. Antepartum hæmorrhage could have resulted from some degree of placenta prævia or from accidental partial separation of the placenta even without signs of toxæmia.

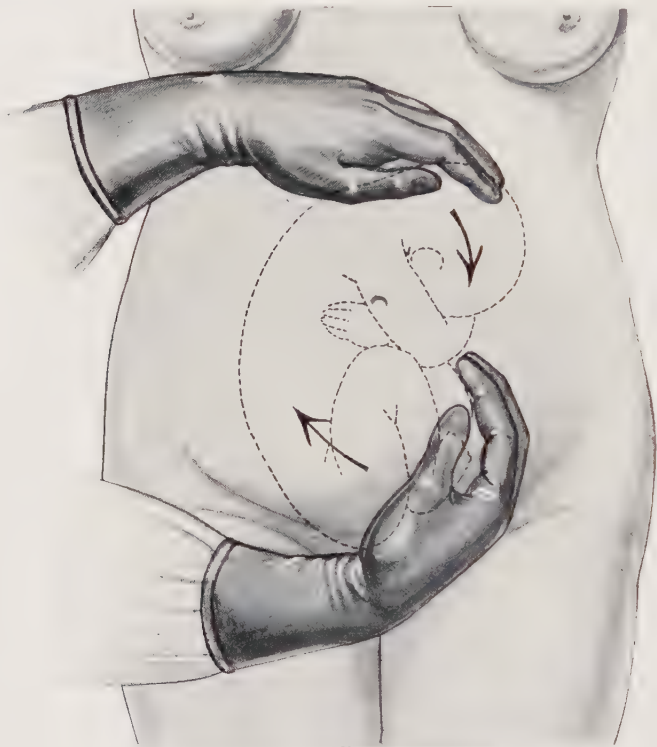


FIG. 204.—EXTERNAL CEPHALIC VERSION.

The patient is lying on her back. Note that the direction in which the child is moved is that which tends to increase rather than to diminish flexion of the head and spine. The use of gloves is not necessary.

In either case it would be obviously hazardous to proceed to external version. Signs of toxæmia would also be a contra-indication. External version would not be done if the patient is ultimately to be delivered by elective Cæsarean section.

Sometimes version has been left too late and the fœtus presenting as a breech is judged too big to turn. This often means that there is an insufficiency of liquor amnii, the uterus moulding itself to the outline of the fœtus. In such a case the breech is often deeply engaged giving the firm impression that it would not budge even if version were

attempted. In all these circumstances version should not be attempted, there must always be a reasonable hope of easy success because force must never be used.

Technique. The patient lies on her back. Manipulations are done only when the uterus is relaxing and then gently and unhurriedly. The abdomen is palpated methodically to confirm the presentation and the suitability of the case for version. The foetal heart is listened to. The patient's abdomen is dusted with talcum powder.

Breech Presentation. The first step is to disengage the breech by lifting it out of the pelvic brim. This is done by slipping the finger tips of both hands beneath it and manœuvring it out to that iliac fossa corresponding to the side on which the foetal back is lying. Supporting the breech here by means of one hand, the other hand seeks out the head in the opposite uterine cornu and then both hands working in unison, one lifting the breech further up on one side and the other firmly pressing the head down on the other side, the foetus is progressively turned. In some cases it goes round quickly and with the greatest ease. In others careful and painstaking manipulation is necessary.

Almost always version is easier when the foetus is turned in the direction in which it is facing. In this way flexion tends to be increased and so the foetal bulk made smaller and easier for turning. When the head is ultimately brought over the brim it should be pressed down into the pelvis to help in maintaining the head presentation. Not uncommonly it will not be possible to cause the head to engage immediately after version, for the head may have become deflexed. The foetal heart should be auscultated after version, and during version, if the manipulation is protracted. It is very common to find that the foetal heart slows when the head is pressed on, but it recovers again quickly when pressure is released. Immediately after version the foetal heart is often slow but the normal rate soon returns in uncomplicated cases.

Before the patient leaves the couch after version the introitus is inspected to note whether or not any bleeding has taken place. The patient should be seen again within the next week to see that the head still presents and to determine if it engages in those cases in which engagement was not possible immediately after version.

It is usually easier to turn a breech with flexed legs than the more common breech with extended legs for the former is usually unengaged, whereas with the latter the opposite is true. Extension of the legs is no bar to version although their splinting action tends to limit flexion of the trunk and also the more streamlined presenting part sinks more deeply into the pelvis. Nevertheless if it is possible to lift the breech out of

the pelvis version may be attempted. But no further endeavour must be made if it cannot. In such cases it is sometimes helpful to admit the patient to hospital and attempt version in the morning before she rises from bed. The Trendelenberg position is also occasionally used to disengage the breech before version is attempted.

Causes of Failure. Version may fail for one of several reasons and should never be looked on as a challenge. Sometimes it is obvious that the foetus has become too big, or there is a deficiency of liquor amnii. But when these features are not present and the chance of success seemed good, failure is often due to part of the breech still being within the pelvis. Very occasionally there is a developmental abnormality of the uterus, uterus subseptus, whereby the short septum in the fundus prevents the head from escaping from the cornu. A cornual implantation of the placenta is thought to have a similar effect and has been thought in recent years to be a common cause of persistent breech presentation. Shortening of the umbilical cord, or looping of the cord round the neck or a limb may prevent version and would constitute an additional danger to the foetus through cord obstruction or placental separation.

Occasionally the presence of another foetus in unsuspected twin pregnancy is the reason why version fails. When the patient is very obese or when the placenta is attached to the anterior uterine wall, the definition of the foetus is obscured enough to make successful version less likely. In much the same way, if version is tried too early the foetus may be too small to define accurately. A very important, yet not very common, cause of failure of version has been left purposely to the last. It is inability of the patient to relax. Unless the abdominal wall has been made tender by previous unsuccessful attempts the vast majority of patients are able to relax sufficiently for version to be undertaken safely and successfully. If, however, the patient is unable to relax her abdominal muscles and successful version would otherwise appear probable, she should be admitted to hospital and prepared for *version under anaesthesia*. Inability to relax is the only indication for this procedure.

Risks. -When version is properly done in carefully selected cases it carries very little risk. Anaesthesia by removing the patient's ability to resist force adds considerably to the dangers. This is not to say that it should be avoided, but only to emphasize that the use of anaesthesia calls for the proper indication and for experience on the part of the operator.

Version can cause partial separation of the placenta and accidental haemorrhage, rupture of the membranes and premature labour or prolapse of the cord. If there is unsuspected placenta praevia it may cause

bleeding. Obliteration of the cord circulation may be caused by a knot.

Rupture of veins in the broad ligament with formation of a broad ligament hæmatoma or hæmoperitoneum can be caused.

Transverse and Oblique Lie.—Unless there is an obvious simple cause such as hydramnios or lax abdominal muscles, the possibility of placenta prævia being present should be thought of and manipulation to bring the head into the pelvic brim done with gentleness and circumspection. If there has been any bleeding already version should be avoided.

When the head has been brought over the brim an attempt is made to make it engage and if this can be done satisfactorily disproportion at the brim and placenta prævia are excluded. If it cannot be made to engage further investigation will be needed and this may take the form of pelvic examination to detect a full rectum, pelvic tumour or contraction ; or X-ray pelvimetry or placentography.

Internal Version.

Internal version can be done only in labour. By this manœuvre the presentation and often the lie of the fœtus are altered by passing a hand inside the uterine cavity ; the other hand manipulates *via* the abdominal wall. In order for internal version to be possible the cervix must have dilated sufficiently to allow a hand to pass through it, at least about four fingers dilatation. It is always *podalic version* and one or both legs are brought down as part of the manœuvre. The patient should always be deeply anæsthetized.

Indications.—Almost the only indication in modern practice is a shoulder presentation and then only under certain conditions. Very occasionally there might still be a place for it in the management of placenta prævia of lesser degree, when rupture of the membranes has not stopped the bleeding and the baby is either very premature or dead. In prolapse of the cord in a multipara when the cervix is not quite fully dilated, the head high and the baby alive, it might be done in order to deliver the child by breech ; in cases of prolapse of the cord when the cervix is not open enough to allow immediate delivery, but enough for internal version and replacement of the cord, and facilities for Cæsarean section not available. Similarly a brow presentation in a multipara with a roomy pelvis could be dealt with by internal version in suitable circumstances.

In former years internal version was a very common way out of almost any obstetric difficulty ; but it was dangerous for the fœtus, as

it was then practised particularly in cases of disproportion. It would never be done now in the presence of pelvic contraction, for the fore-coming head has a much better chance of slowly moulding successfully, than the essentially abrupt passage of the after-coming head in breech delivery, which may become fatally delayed.

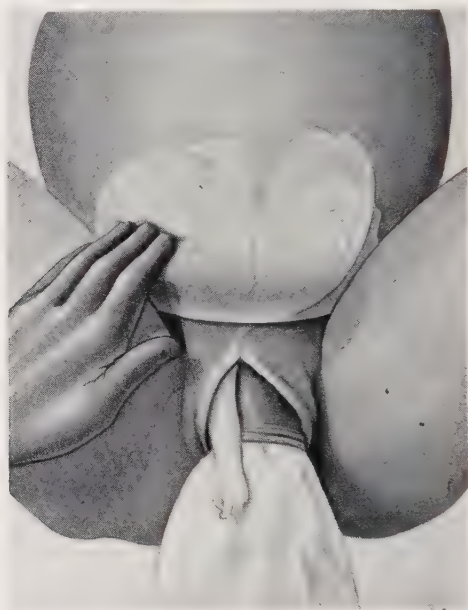


FIG. 205.—INTERNAL PODALIC VERSION. STAGE I. SHOULDER PRESENTATION.

In a shoulder presentation it matters little which hand the operator uses internally. In this case he has introduced the right hand to grasp the lower leg of the foetus and bring it down. His left hand, working outside the sterile sheet, is coaxing the head out of the iliac fossa.

Contra-indications. Internal version is emphatically contra-indicated when labour has been obstructed for so long that the lower uterine segment has become dangerously thin and distended. In these circumstances the foetus is almost always dead and either a destructive operation or Cæsarean section would be far safer; if the foetus lives Cæsarean section would be indicated.

It could not and therefore would not be done if the membranes had ruptured some time previously and the liquor drained away leaving the foetus closely enveloped by the uterus and immobile. Similarly internal version is obviously not possible when the cervix is insufficiently dilated to admit the hand.

Almost always when the foetus is dead it is best avoided and decapitation or craniotomy should be done instead.

In pelvic contraction it is always contra-indicated ; if the fœtus is alive Cæsarean section is the alternative to forceps delivery, and if it is dead either a destructive operation, or Cæsarean section is to be preferred.

Technique.—As the most common indication for internal version in modern obstetrics is a shoulder presentation the manœuvre for changing this to a breech will be described first.

Shoulder Presentation.—The ideal moment for internal version is when the cervix is four fingers dilated and the membranes still intact. The patient needs to be fully relaxed under general anæsthesia.

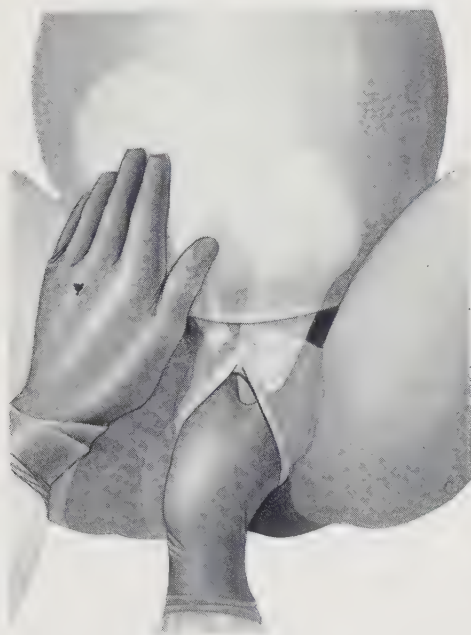


FIG. 206.—INTERNAL PODALIC VERSION. STAGE II. SHOULDER PRESENTATION.

The lower leg is being brought down causing the back to rotate forwards. If the upper leg had been chosen the back would have turned posteriorly. The head has almost reached the fundus.

She is placed in the lithotomy position and the vulva cleaned with antiseptic lotion. Sheets and towels surround the operative field and the bladder is emptied by catheter. Palpation of the abdomen over the sterile sheet confirms the side on which the head is lying and that the uterus is relaxing. A careful vaginal examination is then done and the degree of dilatation of the cervix and the size of the pelvis estimated,

The safety of the cord is confirmed and then the points about the shoulder presentation will be observed, the whereabouts of the head, whether the back is in front or behind and making out the position of the limbs. In a shoulder presentation an arm very commonly prolapses and this has to be distinguished from a leg. The great mobility of the digits is the distinctive feature of the hand whilst the heel immediately identifies the foot.

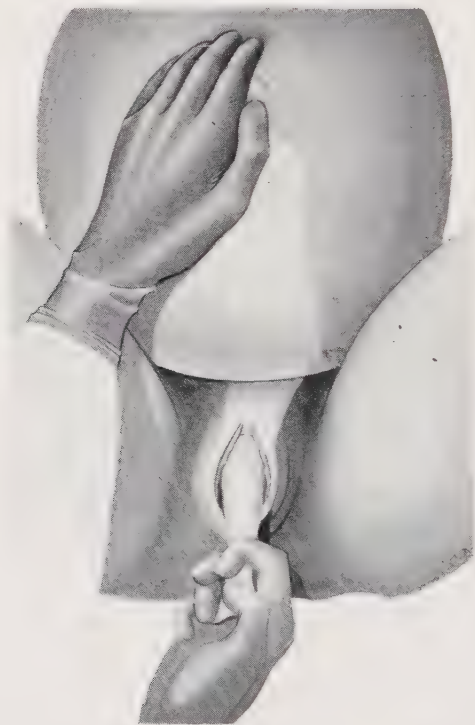


FIG. 207.—INTERNAL PODALIC VERSION. STAGE III. SHOULDER PRESENTATION.

The foot and leg have been brought through the introitus and the head has reached the fundus. If the foetus seems bigger than average, the other leg will be brought down as well, and should the cervix be fully dilated, breech extraction would probably follow.

Having made out these details the next step is to grasp a foot and bring down a leg, but before doing so the membranes should be ruptured if, in fact, they have not already broken. The operator's other hand working outside the sterile sheet on the abdominal wall is of great help in guiding the internal hand and if need be in manipulating the foot to within grasp.

The hand to use internally depends on which side the head is lying. For example, if the head is lying in the left iliac fossa the legs will

lie to the patient's right side, and it is easier for the operator to pass his right hand to the patient's right side internally. Therefore, if the head lies to the patient's left side the operator uses his right hand internally; and if to the patient's right side the left hand internally. In practice with a shoulder presentation it does not matter a great deal which hand is introduced.

The foot to grasp varies according to whether the foetus is lying dorso-anterior or dorso-posterior. The principle is always to end the manœuvre with the foetus's back pointing anteriorly. Hence if it is lying dorso-anterior the lower foot of the foetus is grasped and brought down and its back will then stay in front. On the other hand when the position is dorso-posterior the upper foot is taken and drawn down and the effect of this is to rotate the foetus's back to the front as it comes down.

As the leg is being brought down by the operator's internal hand, his other hand on the patient's abdomen gently manipulates the head from the iliac fossa up towards the fundus, for internal version is not achieved only by internal manipulations, it is a combined internal and external manœuvre. In conducting intra-uterine manipulations it is of the utmost importance to be gentle. Nothing should be done during a uterine contraction and the hand must be kept quite still until it passes off.

When the leg has been brought down so that the knee appears at the vulva, and the head by now is in the fundus, version is deemed complete.

It is usual to bring down only one leg, even when breech extraction is to follow immediately and to deliver as a half-breech. If, however, the foetus seems bigger than average it is better to bring down the other leg too, either with the first or after it. If the dilatation of the cervix permits it, breech extraction will now follow and it is done in the manner described in Chapter XXX. When the foetus has been delivered the operator should pass his hand inside the uterus again to make sure it has not been ruptured.

Head Presentation.—The abdominal examination confirms on which side the back is lying for this determines which hand is used for the internal manipulation. When the back lies to the left the operator uses his left hand and when to the right, the right hand. Only in this way will the palm of his internal hand correspond with the position of the legs of the foetus. Having introduced the correct hand the head is pushed into the iliac fossa of the side on which the back is lying. It is then slid gently up the ventral surface of the foetus and at the same time the outside hand presses the breech over and down the side of

the uterus opposite to the back. A foot in this way comes within reach of the internal hand which grasps it and draws it down; it is immaterial which foot is seized in this instance. The outside hand as before, working in unison with the hand in the uterus works the head up to the fundus. It is a more risky procedure than when the foetus is lying transversely so that existing conditions must be favourable fully to justify its use.



Fig. 208.—INTERNAL PODALIC VERSION. STAGE I. HEAD PRESENTATION.

The hand whose palmar surface corresponds with the foetal abdomen (in this case, left) is passed through the cervix and displaces the head into the iliac fossa on the same side as the back. The operator's outside hand, working over the sterile sheet, coaxes the breech and leg down to within the grasp of the internal hand.

Risks.—It is difficult to think of any obstetric procedure which carries a greater risk for both mother and child. This is because its safety and success depend on the good judgment and skill of the operator and because the conditions for which it is indicated are inherently dangerous. Breech extraction and prolapse of the cord, and placenta prævia treated by this method, are hazardous for the foetus particularly from either intracranial hæmorrhage or compression of the cord, or the low lying placenta. The danger to the patient lies chiefly in the likelihood of rupture of the uterus; Cæsarean section may be a safer

alternative. Even when the version has been easy the uterus should always be explored after delivery to make sure that there is no rupture.

The cervix may be split or the vagina or perineum badly lacerated. Hæmorrhage would be expected from any of these traumatic complications, but in rupture of the uterus the external loss may be very little.

Traumatic shock, or hæmorrhagic shock, or both, may accompany any of the more serious lacerations. Sepsis may follow internal version. Yet if care has been taken with aseptic and antiseptic technique this risk today with effective antibiotic prophylaxis and therapy is comparatively small.

On reviewing the risks associated with internal version the serious dangers naturally stand out and it is quite right that they should. For today except in special circumstances, it is seldom that internal version would carry less risk than Cæsarean section.

Bipolar Version (Braxton Hicks's Manœuvre).

In 1860 John Braxton Hicks published his method of combined external and partly internal version. It was one of the most outstanding contributions to the obstetrics of his day for it removed many of the dangers of internal version and, whilst its use was advocated for correcting all kinds of malpresentations as well, its main use was in the management of lesser degrees of placenta prævia. Hicks wrote, "Turn, and if you employ the child as a plug the danger is over . . .".

Bipolar version can be done at an earlier stage in labour than can internal version for it only requires the cervix to be sufficiently dilated to admit two fingers. This type of version is always podalic and one leg is brought down through the cervix. It is usually only possible to do it if the membranes are still intact or have only just ruptured. But if the membranes are intact before proceeding to bipolar version it is always worth considering if external version is still possible. If it is and the breech brought over the brim all that remains is to rupture the membranes and hook down a foot thereby reducing internal manipulations to a minimum. Bipolar version is technically the most difficult form of version to perform.

Indications. Today its use is necessarily restricted because Cæsarean section has been extended to cover more safely, for the foetus at least, many of the indications that Hicks gave. But even now it might be used in a minor degree of placenta prævia when rupturing the membranes fails to stop the bleeding and the foetus is either very premature or dead. The foetus is turned from a head to a breech, a leg brought down and the bleeding edge of the placenta compressed by

the half breech, if necessary by the addition of a small weight attached to the foot. It is compression of the placenta and possibly the cord, with dangerous effects on the foetus, that makes the method largely unacceptable today, except in the circumstances mentioned. It is however, safer for both the foetus and the mother than the now out-moded use of Willet's scalp forceps. When a multipara in early labour



FIG. 209.—BIPOLAR VERSION. STAGE I.

The index and middle fingers of the hand whose palmar surface corresponds to the foetal abdomen (in this case the left) are passed through the cervix and the head lifted away towards its back. At the same time the operator's other hand, working over the sterile sheet, pushes the breech and legs down the opposite side of the uterus towards the waiting internal fingers.

with the membranes just ruptured is found to have a shoulder presentation and the cervix is at least two fingers dilated, bipolar version would be considered.

Technique.—The same preliminary preparations as described for internal version are necessary; the patient must be fully relaxed under anaesthesia and in the lithotomy position. If the membranes have not ruptured already this would be done immediately after the internal manipulations have been completed but before a foot is grasped.

When the head presents the hand to pass into the vagina is the one whose palmar surface faces the foetal abdomen. Thus, if the foetus faces to the left, the right hand is used and *vice versa*. Only thus will it be possible to hook the fingers round a foot when it is pushed down by the outside hand. When the shoulder presents the right hand is used when the head is in the left iliac fossa and the left when it is in the other.



FIG. 210.—BIPOLAR VERSION. STAGE II.

When the foot is recognized by the internal fingers, the membranes are ruptured, the foot grasped and hooked down through the cervix. The operator's other hand, on top of the sterile sheet, seeks the head in the loin and coaxes it up to the fundus.

Head Presentation—The index and middle fingers are passed through the cervix, the membranes being kept intact, and the head lifted away towards its back. At the same time the operator's other hand working outside the sterile sheet on the abdomen pushes the breech and legs down the opposite side of the uterus where a foot is recognized by the fingers of the internal hand. The membranes are now ruptured and the fingers hooked round the foot which is drawn down through the cervix. At the same time the outside hand coaxes the head up into the fundus. The manœuvre is complete when the knee is through the cervix and the head is in the fundus. If continuous

traction is to be applied, a bandage by means of a clove-hitch is attached to the ankle and the other end led over a pulley on the end of the bed to a half-pound weight.

Shoulder Presentation.—The correct hand is introduced, the fingers are passed through the cervix and the shoulder elevated. The outside hand at the same time lifts the head from the iliac fossa towards



FIG. 211.—INTERNAL PODALIC VERSION. STAGE II. HEAD PRESENTATION.

The operator's finger has been slipped into the crook of the knee to draw the leg down. His other hand will now seek the head in the iliac fossa and, working on top of the sterile sheet, guide it into the fundus as traction is made on the leg.

the fundus. When it is there or thereabouts the outside hand is shifted down to press the breech from the opposite iliac fossa towards the pelvic brim so that the internal fingers can grasp a foot. The operation is then completed as already described.

Risks.—The risks of bipolar version are concerned largely with the fœtus and some have been mentioned already. It will be seen that the risk is not so much in the manœuvre itself but rather what happens later. In prolapse of the cord and placenta prævia the danger lies in cord or placental compression during the rest of the labour; in shoulder presentation the subsequent breech delivery.

The risk to the patient should be minimal with ordinary care, for the operation is only possible relatively early in labour with the foetus mobile, the membranes usually intact and the lower segment as yet not distended and thin. These were the conditions that made it possible for Hicks to reduce the maternal mortality, in his day by its aid from 30 to 5 per cent.

CRANIOTOMY

Craniotomy is done when the foetus is dead and labour obstructed by apparent or real cephalo-pelvic disproportion. Its aim is to reduce the size of the head so that delivery may be effected with minimal disturbance to the patient. It is also done in cases of unmistakable hydrocephalus.

The Indications for Craniotomy. (1) When the foetus is dead but conditions suitable for assisted vaginal delivery (see Forceps, p. 518) other than the cephalo-pelvic disproportion; for instance an impacted persistent occipito-posterior of the vertex or mento-posterior position of the face. In persistent occipito-posterior the difficulty has often arisen because the pelvis is of the cramped android type or the baby is excessively big or both. Sometimes the head in a brow presentation manages to enter the pelvic cavity, when the baby is small and the pelvis roomy, and becomes obstructed. The after-coming head of a breech may become obstructed from extension or from unsuspected pelvic contraction.

(2) Hydrocephalus. In this condition it is only when the head is presenting that it is perforated. When the breech presents the size of the head can be reduced by decompressing it *via* the spinal canal. The danger of hydrocephalus when the head presents is that the cervix may begin to split well before it has become fully dilated so greatly does it have to stretch to encompass the enlarged head. When the diagnosis has been made antenatally (and it should be easily recognized), the principle is to allow labour to begin, but as soon as the cervix is dilated enough (usually three fingers) to allow it, the head is perforated with a wide-bore needle and stylet or a Drew-Smythe catheter. The excess cerebro-spinal fluid escapes quickly and the head collapses. Labour then proceeds normally; when the hydrocephalic head is after-coming in breech delivery it is collapsed after the shoulders have been delivered by passing a Drew-Smythe catheter up the spinal canal *via* the spina bifida if one is present; or by opening the spinal canal in the upper dorsal region and passing the catheter in at that level.

After decompression the head will be delivered easily by traction on the trunk.

Technique.—Delivery in obstructed labour is composed of two stages ; (1) Perforation and (2) Extraction.

The preliminary preparations are the same as for any vaginal obstetric operation.

(1) Perforation.

Of the various instruments that have been devised to perforate the head of the child either that of Oldham, or Simpson's modification, is the best (Fig. 212). The head can, if necessity demands, be perforated with a pair of sharp-pointed scissors.



FIG. 212.

Oldham's perforator consists of two halves joined together by a bolt. Each half has a cutting blade, a shank, and a handle. Where the top of the shank passes into the blade it is broadened out, so as to form a shoulder.

The patient is placed in the lithotomy position, and if the head is not fixed in the pelvis, the assistant should press down the foetus from the abdomen so that the head may remain steady.

It is important that the cervix should be fully dilated (except in hydrocephalus) before the perforation is commenced since, when the woman is at term, great difficulty may be encountered in trying to deliver the shoulders through an imperfectly dilated cervix, and the danger to the mother will be materially increased from the sharp edges of the perforated skull which may tear the walls of the birth-canal.

The operator inserts his left hand into the vagina until the finger-tips impinge on the head. Grasping the perforator in the manner shown in Fig. 213, the point protected by the fingers of the left hand is guided to a portion of the scalp which covers a frontal bone, care being taken that the promontory of the sacrum is not mistaken for a portion of the cranium. To ensure that the point of the perforator is at right-angles to the bone to be perforated, the shank of the instrument is next placed against the perineum, after which the

point is made to perforate the bone by a rotating movement. If it is sought to perforate the bone by a sharp thrust, the instrument may slip off and seriously injure the maternal tissues. When the perforator has been forced into the cranial cavity as far as its shoulder, the operator by approximating its handles and so separating the points, lacerates the

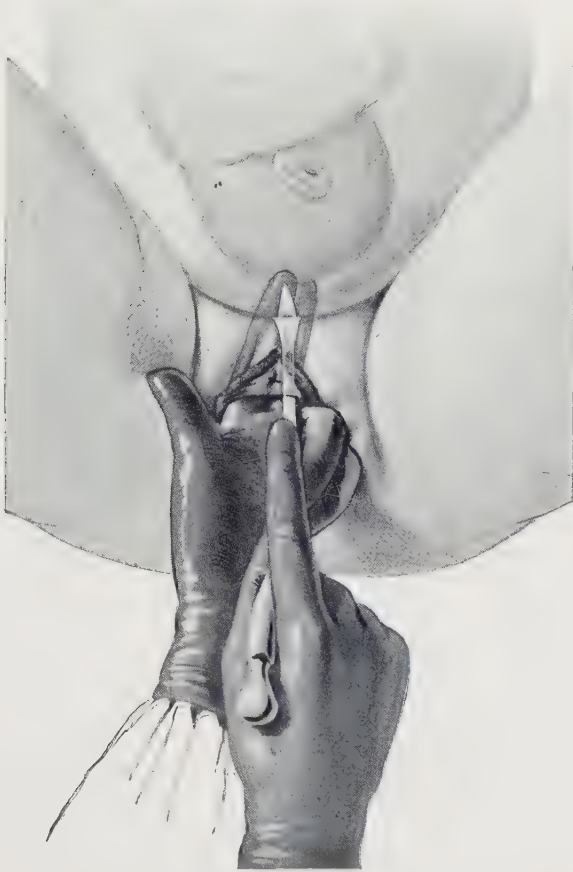


FIG. 213.—PERFORATION OF THE FETAL SKULL. STAGE 1.

Showing the perforator guided to the child's head by the index and middle fingers of the left hand of the operator. The head in the figure is not fixed and would be held at the brim by an assistant.

bone (Fig. 214). The handles are then separated, and rotated a quarter of a circle, and by again approximating the handles a laceration is made in the bone at right angles to the first one. It is necessary for the bone to be perforated and not a fontanelle or suture, since the tendency is for an opening between bones to be closed by the sliding of one

bone over the other from the pressure on the head. The brain is then broken up by stirring with the perforator.

The object of perforation is to allow the head to collapse under pressure from the natural forces or by some instrument.



FIG. 214.—PERFORATION OF THE FŒTAL SKULL. STAGE 2.

Showing the perforator pushed in as far as the shoulders of the blades, the handles approximate and parts of the blades separated.

2 *Extraction*

Following perforation the head may be extracted by the forceps. If the head is still too large it may be crushed by the use of the cephalotribe or the bones of the vault may be removed with the cranioclast.

Traction by either of these instruments will complete the delivery of the head.

Winter's three-bladed cranioclast and cephalotribe has combined the functions of the earlier instruments.

The Three-bladed combined Cranioclast and Cephalotribe.

—This instrument is composed of three parts, one of which is furnished with a sharpened point, and carries the pin of the French lock to which the other two blades are fitted (Fig. 216). The other two blades have a small head curve and serve as the crushing blades. A screw and pinion are hinged to the central blade and can be made to operate upon each crushing blade in turn. Two slotted metal strips are hinged

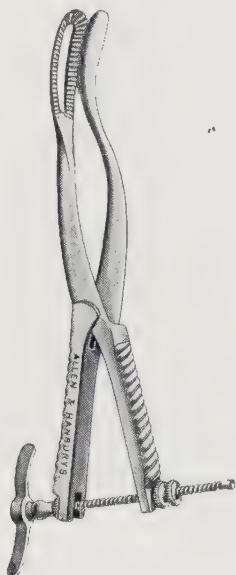


FIG. 215.—CRANIOCLAST.

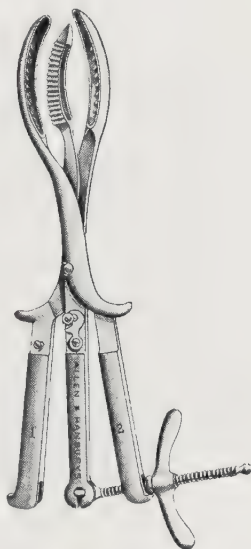


FIG. 216.—COMBINED CRANIOCLAST
AND CEPHALOTRIBE.

to the handle of the central blade and serve to lock the crushing blades tightly when screwed up to the utmost. Then the blades are held firmly together when the crushing is complete. Finally the instrument is used as a tractor to deliver the head.

Cranioclast.—When this instrument is used as a tractor the fenestrated blade is passed outside the scalp, over the frontal or occipital bone. The solid blade is then passed through the perforation into the cranial cavity, so that the bone and scalp are between the blades. The head being firmly gripped is then gently extracted.

When this instrument is used in the operation of cranioclasm the solid blade is passed into the interior of the skull through the perforation hole, and the fenestrated blade between the scalp and the bone. The handles are then tightly screwed up, the cranioclast twisted, and

when the piece of bone is loosened it is withdrawn in the left hand of the operator so protecting the vagina from any sharp pieces of bone.

Whichever method of delivering the head of the child is employed it occasionally happens, especially when the pelvis is markedly contracted or the child is beyond the normal size, that further difficulty is encountered with the body of the child. In this case the arms

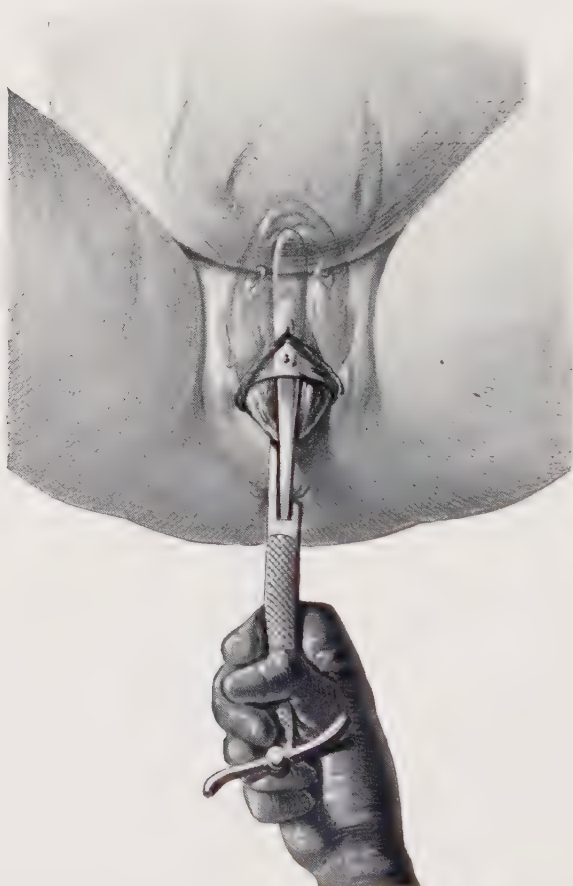


FIG. 217.—DELIVERY OF THE CHILD WITH THE CRANIOCLAST.

Showing one blade inside the foetal skull and the other outside. The left hand of the operator would be inside the vagina to prevent laceration of its walls by sharp edges of bone.

may be brought down and used as an additional means of traction, or the blunt hook may be passed under one or other axilla of the child for the same purpose. The breadth of the shoulders may also be lessened by dividing the clavicles (cleidotomy).

Choice of Methods.—In most cases it is best to use a three-bladed cephalotribe. Since Cæsarean section is resorted to much more frequently nowadays, the necessity for performing craniotomy is becoming less and less frequent.

Perforation in Face Presentation and of the After-coming Head.—If it is necessary to perform craniotomy and the face is presenting, the perforator should be pushed into the cranial cavity through the orbit, care being taken to push towards the mid-line.

If it is necessary to perforate the after-coming head the perforator should be pushed into the cranial cavity through the occipital bone, the legs of the child being pulled forwards or backwards as the case may be; the head will thereby be fixed, and the body being held out of the way the perforator can more easily be introduced. After the head has been perforated it can be delivered very easily by traction on the legs. In rare cases it may be necessary to use the craniotomy forceps or cephalotribe to effect extraction.

DECAPITATION

The operation of decapitation amounts to severing the neck of the dead foetus while still *in utero*.

Indications.

- (1) In impacted shoulder presentations.
- (2) In certain cases of locked twins when disengagement is not possible.
- (3) Very rarely in certain cases of double monsters.

Preparation.—The preparation for the operation is the same as that described for delivery by the forceps. The patient should be in the lithotomy position under anæsthesia.

Operations.—Several methods are available.

- (1) Blond-Heidler thimble and saw.
- (2) Blunt hook and scissors.
- (3) Sharp hook.

It is just as important in this operation as in any other to examine the patient carefully to make out the exact state of affairs and the position of the foetal parts.

Technique.

(1) *Blond-Heidler thimble and saw.* This instrument first described in 1923 is ingenious, safe and very effective in beheading the dead foetus in an impacted shoulder presentation. It consists of a wire saw with a protective covering everywhere other than near its middle where the cutting is to be done. At each free end there is a large metal bead that fits into a slot in the metal grip which is attached to the saw after it has been passed round the neck of the foetus.

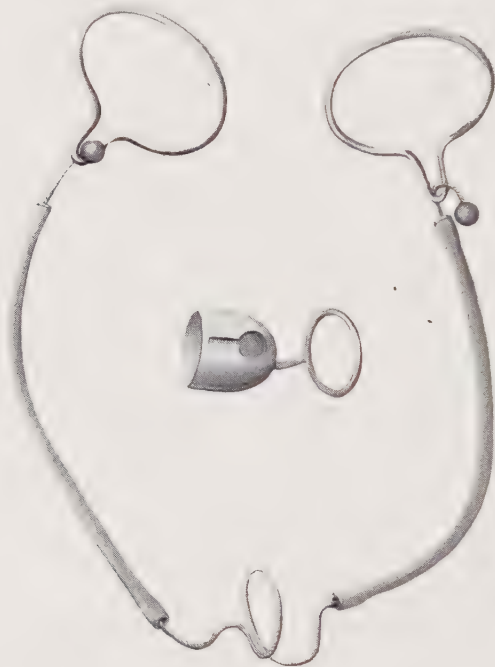


FIG. 218.—BLOND-HEIDLER WIRE SAW AND THIMBLE.

This essentially consists of a wire saw covered by rubber except for a few inches at its centre. A loop-type steel wire traction handle slips on to each end for sawing. The other part of it is a thimble slotted on the side to carry one end of the saw and bearing a loop on its summit.

In order to apply the saw to the neck there is a metal thimble that fits on the thumb of the introducing hand. The thimble has a linked ring attached to its dome into which the operator's middle finger curving round the neck will be inserted to disengage the thimble from the thumb and draw it with the attached saw over the neck and out of the vagina. The thimble has a slot for receiving the metal bead on the end of the saw. When the saw has been applied the metal handles

FIG. 219.—INTRODUCING THE BLOND-HEIDLER SAW.

The thimble is worn on the thumb of the hand introducing the saw and is readily transferred to the middle finger of the same hand curving over the foetal neck and slipping into the loop on the thimble. The thimble carrying the saw is thus transferred from the operator's digit in front of the neck to his digit behind it.

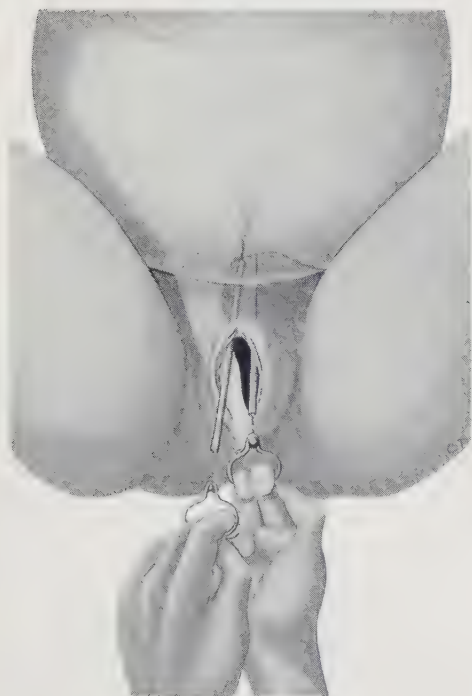
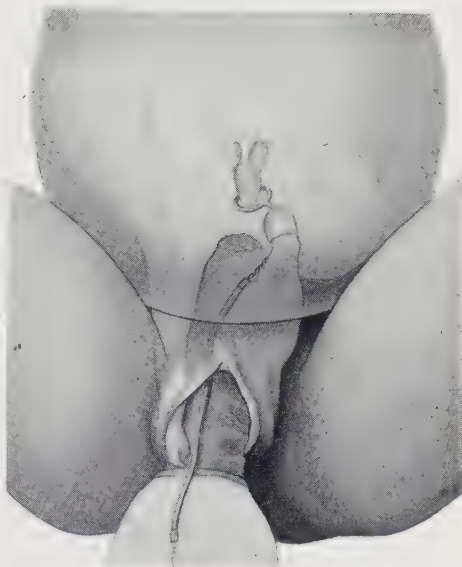


FIG. 220.—BLOND-HEIDLER SAW IN POSITION.

When the operator's hand is withdrawn the saw glides up over the neck of the foetus and sawing can begin.

are attached to each end. With short to and fro sawing movements the neck is severed very quickly and easily and with the minimum of intra-uterine disturbance.

(2) *Blunt hook and scissors*.—One advantage of this method is that it can be used even when special instruments are not available. The hook can be dispensed with and all that is needed is a strong pair of blunt ended scissors with long handles. The instrument is blunt-ended

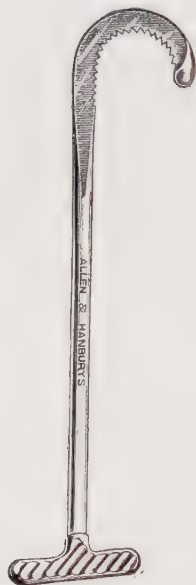


FIG. 221.—TARGETT'S
DECAPITATING HOOK.

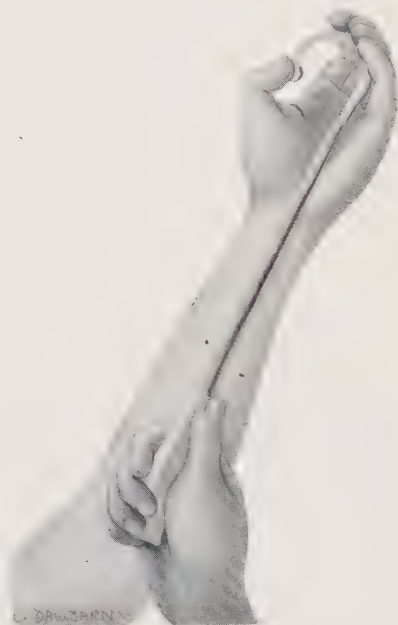


FIG. 222.—RAMSBOTTOM'S SHARP HOOK.

It is held and introduced in the manner shown.

and is passed up the palmar surface of the left hand until the neck is reached. Decapitation is performed slowly and deliberately, the blades of the scissors being directed by the fingers of the left hand, which also guards the maternal tissues from damage.

(3) *Sharp hook*. This method is described because most units have the instrument and it is judged to be the one next in order to the Blond-Heidler apparatus in both effectiveness and safety.

It is a wide hook with a blunt end, a sharp cutting inner edge and a long handle.

The same preliminaries are observed as with the blunt hook and scissors method. The handle of the hook is held in the right hand and the instrument introduced with the hook cupped in the protecting

fingers of the left hand, the hook at this stage lying parallel to the neck. It is passed up between the thorax and the anterior pelvic wall to just above the neck. It is then rotated in its long axis through a right angle to carry its cutting edge over the neck. The fingers of the operator's left hand are next passed round to the other side of the neck to confirm a correct application and remain there protecting the maternal tissues from possible trauma from the blunt end of the hook. To and fro movements of the handle combined with traction sever the neck.

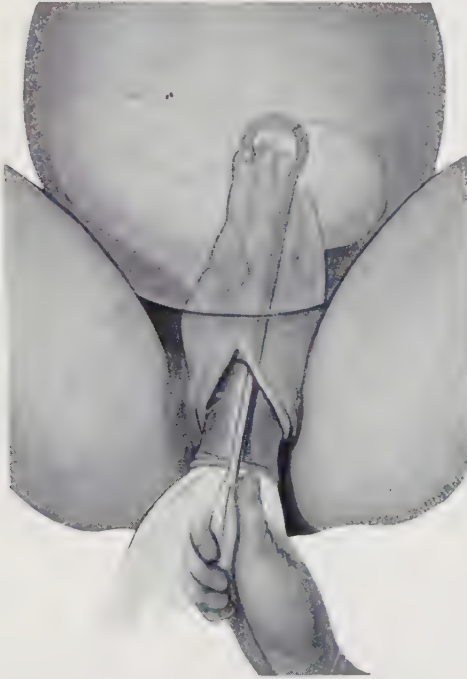


FIG. 223.—INTRODUCING THE DECAPITATION HOOK. STAGE I.

The maternal tissues are protected by the operator's hand until the hook is fully introduced to the level of the neck of the fetus.

Delivery of Trunk and Head. After the neck of the fetus has been divided the body is easily delivered by pulling on the prolapsed arm. The decapitated head is finally delivered spontaneously, or failing this by the forceps or by the fingers inserted in the mouth. If the pelvis is contracted great difficulty may be experienced in delivering the head, in which case it may be necessary to use the cephalotribe or cranioclast.

Difficulties and Dangers.—The chief difficulty is in finding adequate room and the chief danger is damage to the maternal tissues. The left

hand should always shield the soft-tissues from the instrument when introducing it and cutting.

If the pelvis is much contracted or the uterus over-retracted it may be necessary to eviscerate the child or even cut through its back (spondylotomy) before the neck can be reached. This would only be considered if facilities for Cæsarean section were not available.

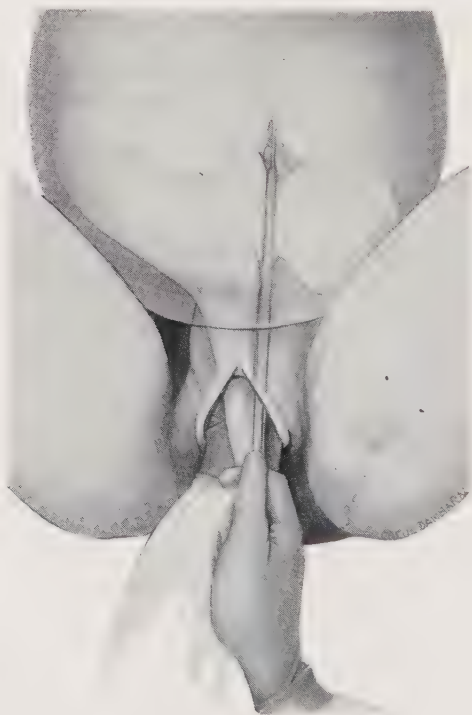


FIG. 224.—INTRODUCING THE DECAPITATION HOOK. STAGE II.

The operator's hand is withdrawn and then passed behind the neck of the foetus. The hook is then rotated through 90°, so that it comes to lie snugly across the neck, the operator's internal fingers continuing to protect the mother's tissues. Sawing can now begin.

Decapitation is attended by a high maternal mortality usually due to the neglected state of the case. A careful pelvic examination should always be made after delivery to detect and treat any serious damage that may have been inflicted.

EVISCEARATION

Indications.—1. Impacted shoulder presentation when decapitation cannot be performed.

2. Increased size of the thorax or abdomen (fluid, tumours) preventing the birth of the child.

Operation.—The preparation of the patient is the same as that for the application of the forceps. The body of the child being fixed by traction on a prolapsed arm, or by pressure from above, the operator



FIG. 225.—EVisCERATION OF THE CHILD IN A TRANSVERSE LIE.

passes the left hand into the vagina till the fingers reach the abdomen or thorax as the case may be. A pair of embryotomy scissors is then passed with the right hand along the palmar surface of the left hand and the abdomen or thorax opened (Fig. 225). The viscera are removed with the left hand, and the rest of the child delivered by traction. The uterus is finally douched with an antiseptic solution.

CLEIDOTOMY

Indication.—The birth of the shoulders is sometimes delayed owing to their abnormal size, especially in very large babies and anencephalic monsters. Other methods of delivery having failed, it may be necessary to divide the clavicles.



FIG. 226.—CLEIDOTOMY.

Showing the clavicle being divided.

Operation.—The operator places the finger of the left hand on the clavicle of the child, and thus guided divides the clavicle with a strong pair of scissors. The body is afterwards delivered by traction on the head or feet (Fig. 226).

CUTTING OFF THE LEGS OF THE CHILD

In certain cases of impacted breech when great difficulty is experienced, or it is impossible to bring down the legs of the child, they may be amputated through the thighs by Ramsbotham's hook or scissors.

SYMPHYSIOTOMY

This operation was first used by Sigault in Paris in 1777 in cases of obstructed labour due to pelvic contraction. With the advent of Cæsarean section the operation became almost obsolete.

In comparatively recent years it has been revived to some extent particularly in Dublin on the thesis that a uterus with a Cæsarean section scar is forever potentially weak. On the other hand it is argued symphysiotomy is a minor operation, the pelvis is permanently enlarged and the uterus remains intact.

Now that antibiotic cover is available infection is only a rare complication. The disadvantages of the operation are that the pelvic girdle is sometimes rendered unstable and permanently uncomfortable ; stress incontinence is a common complication, although it is not necessarily permanent.

The indications for symphysiotomy as pronounced by the Dublin School are wide and varied and are not accepted by the majority of obstetricians. In the main it may be said that symphysiotomy could be expected to be successful in cases of cephalo-pelvic disproportion of medium degree at any pelvic level. For disproportion at the brim this would mean a patient who had been selected for trial labour when the addition of just a little more room would result in a successful vaginal delivery. Disproportion in the cavity or outlet giving rise to delay in labour would be discovered during the careful vaginal assessment of the cause for delay and a decision reached as to whether or not symphysiotomy would give the additional room needed.

In Dublin the operation is not uncommonly done for disproportion at the brim either before labour begins or during the first stage when it has been decided that the operation will certainly be required (medium to major disproportion) and labour allowed to continue ; but in cases of delay in the cavity or outlet the operation is more usual in the second stage and forceps delivery may follow.

Technique.—The preliminaries are the same as for any vaginal operation. General anæsthesia is usually employed although local infiltration is satisfactory. The patient is in the lithotomy position

with legs supported. It used to be thought that an assistant supporting each lower limb was essential to prevent the pelvis from springing apart when the symphysis is divided but this is not necessary. The bladder is emptied by catheter.

A vertical incision is made about 2 to 3 inches long centred over the top of the symphysis and at the spot where palpation suggests the joint lies. The incision is deepened to expose the symphysis and about the lowest inch of the rectus sheath which is now carefully incised to allow the passage of the index finger. The finger is passed down behind the symphysis pushing the bladder back, as far as the arcuate ligament. Some time may be spent in locating the joint space for it tends to be on a crest rather than in a hollow. When it is found using a solid bladed scalpel and with the finger always behind and below it with careful strokes the cartilage is divided forwards and from above downwards. When the arcuate ligament is cut through in the depths of the wound the joint suddenly opens enough to admit two fingers.

Bleeding is not often a problem: it can usually be controlled by gauze packing until delivery is complete. If it continues and the bleeding point cannot be seen the packing should be left in for 24 hours under local and general antibiotic cover.

The wound is closed after injecting 200,000 units of penicillin into the joint cavity, a dressing is applied and a many tailed binder used to support the pelvis.

A catheter should always be passed to detect hæmaturia which would suggest vesical or urethral injury. No special nursing is needed but the pelvic binder is worn for a week and the patient allowed up on the 10th day. A pelvic belt is not needed except for occasional patients who may feel in need of one. Full painless locomotion may be expected in 4 weeks but heavy weights should not be carried for 3 months.

EPISIOTOMY

The word literally means incision of the epision or "the region of the pubes", which is, of course, the perineum.

It is a minor operation yet is capable of conveying beneficial effects out of all proportion with its diminutive technique. Apart from increasing the safety of many obstetric procedures, a timely episiotomy can reduce the duration of labour.

The indications for episiotomy are :

- (1) As part of the routine in breech delivery.
- (2) In premature labour.
- (3) Whenever the perineum is about to tear.

- (4) Delivery with the occiput in the posterior position.
- (5) When there is significant outlet contraction.
- (6) After the successful repair of a complete tear of the perineum and after colporrhaphy.
- (7) In some obstetric operations.
- (8) For some obstetric emergencies.

Breech delivery. The time to perform episiotomy is when the breech is fully distending the perineum. The special indications are (i) to avoid the commonest cause of intracranial hæmorrhage in breech delivery, cranial stress at the pelvic floor and vulval ring, (ii) to anticipate



FIG. 227.—EPISIOTOMY.

and make easier the bringing down of extended arms, (iii) to avoid causing a complete perineal tear, in doing so (iv) to avoid the need for the breech with extended legs to flex over the perineum and thus to facilitate delivery.

Episiotomy should be done as part of the routine in breech delivery in all primiparæ and in the majority of multiparæ.

Premature labour. The reason in cases of premature labour is to avoid cranial stress to which the soft, relatively large head of the premature fœtus is so susceptible. Episiotomy is now a routine prophylactic measure in such cases.

Whenever the perineum is about to tear.—It is thus very commonly indicated in primiparæ when the head is about to crown and in multiparæ when the perineum has been well sutured at a preceding delivery.

Occasionally the perineum begins to split in the centre. An incision is even more urgently needed in these circumstances.

Delivery with the occiput in the posterior position.—When the occiput has rotated posteriorly and progress is good, spontaneous delivery can be anticipated ; indeed the fact that it is posterior is by no means always recognized up to this stage. A suspicious sign is an exaggerated degree of gaping of the anus. The reason is that the wide bi-parietal diameter, being posterior, is over-distending the peri-anal structures. Episiotomy is particularly indicated in such cases for the twofold purpose of reducing cranial stress and the serious risk of major perineal rupture.

Outlet contraction.—This is most commonly seen in the android type of pelvis in which the sub-pubic angle is reduced. When there is enough room in the sagittal diameter the head retreats from the symphysis in order to escape but in doing so of necessity causes increased tension in the perineum ; a generous relieving incision is essential.

Previous complete perineal tear repair, or colporrhaphy.—The indication is to avoid uncontrolled laceration of the perineum. It is pertinent too to reflect that patients who have had a complete perineal tear seldom have cystocele or stress incontinence suggesting that the more frequent use of an adequate episiotomy at delivery might confer a more reliable insurance against these complications in the years to come.

Some obstetric operations.—The commonest obstetric operation for which episiotomy is indicated is forceps-delivery in a primipara, but it is by no means always necessary, especially if the light Wrigley's forceps is used. It may be indicated before the introduction of a hand into the vagina for the purpose either of examination to discover the cause of delay or of rotating an occipito-posterior presentation.

Some emergency deliveries.—When the cord prolapses with late rupture of the membranes in the second stage of labour, and especially if the patient is a multipara, the head will often be showing at the time the complication is discovered. By encouraging the patient to push and incising the perineum at the appropriate moment, extra stress can be avoided and the foetus delivered often long before the requisite facilities for forceps delivery are at hand.

Episiotomy can be life-saving when the foetal distress threatens at the perineal stage of delivery. The cause in this case is probably that the cord is becoming increasingly tight round the neck ; a foetus lost at this stage is an avoidable tragedy. In all cases of forceps delivery for established foetal distress it is usually best to incise the perineum in the interest of the foetus.

Technique.—The operation varies in its scope from an incision less than an inch long to one extending for the whole length of the perineum and beyond, but swinging to one side to clear the anal sphincter. Different forms of episiotomy have been described, lateral, bilateral and obliquely lateral, or medio-lateral, but these all have serious disadvantages and should not be used.

The only practical type of episiotomy is the median. The incision should keep to the mid-line for the tissues heal so much better here than when the incision is placed laterally, there is less bleeding and suturing being easier, is more precise. The lateral, or medio-lateral episiotomy, has all the disadvantages when matched against the median; not nearly so favourable healing, more bleeding and more difficult suturing. If placed more laterally still the duct of Bartholin's gland may be severed allowing mucus seriously to interfere with healing.

Anæsthesia.—Local infiltration with xylocaine (1 per cent.) 10 ml.; adrenalin (1 : 1000) 0.25 ml; hyalase 500 Benger units. The perineum in the line of the incision is injected with 10 ml. of the solution. The operation may, of course, be done under general anæsthesia which may already be in use for forceps delivery; or pudendal block may have been instituted. It is sometimes done under gas and air, or trilene and air, but if local anæsthesia can possibly be used it should not be omitted.

The incision is best made at the height of a contraction when the presenting part is fully distending the perineum. If a knife is used two fingers are passed into the vagina between the presenting part and the perineum to protect the former when the incision is made deeply, beginning at the fourchette in the mid-line and extending backwards. If scissors are used it should be the blunt pointed instrument, one blade being inserted on the flat between the presenting part and the posterior vaginal wall, and the other being outside. The tissues between the skin of the perineum and the lower posterior vaginal wall are incised; the structures being, firstly the decussating fibres of the bulbo-cavernous muscles, the perineal body, a fibro-muscular condensation from the above muscles, and the transversus perinei muscles. The external sphincter ani may be exposed but not cut; if the episiotomy needs to be extended the incision should curve out laterally to be outside the line of the ipsolateral sphincter ani bundle. It is important constantly to watch for this incision extending by tear towards the anus during delivery.

Suturing is best done when the third stage has been completed, bleeding points being clipped with hæmostats or ligated with fine catgut in the interval if need be.

The incision is closed with interrupted sutures of No. 0 chromic catgut throughout, except for the perineal skin, on a curved round-bodied needle. First the vagina is closed from above downwards to

the hymeneal ring ; then the bulbo-cavernosus muscles and perineal body with one deep suture in each. Finally, the perineal skin is sutured using a curved cutting needle and fine monofilament nylon.

None of the sutures should be tied too tightly for the subsequent œdema may cause strangulation and necrosis of tissue, including the skin. A sterile pad is applied, and the wound is gently swabbed with antiseptic lotion ; a fresh pad is applied after each use of the bed-pan.

CHAPTER XLI

CÆSAREAN SECTION

CÆSAREAN section is an operation by means of which the fœtus is delivered through an incision in the pregnant uterus after the beginning of the 28th week of pregnancy.

Historical Note. —The origin of uterine section for delivering the fœtus is uncertain, but it is known to be of great antiquity. References are made to it in ancient Rabbinical writings about 140 B.C., yet it was known to have been practised on the dead pregnant woman long before this. The second King of Rome, Numa Pompilius (762-715 B.C.) through a law known as the *Lex Regia* forbade burying a pregnant woman after death before the fœtus had been cut out. This law later, in the reign of the Cæsars, became the *Lex Cæsarea* and it would appear obvious that the present day term “Cæsarean section”, arose in this way, being first used, it seems, by James Guillimeau in 1598.

The first works on the subject began to be published in the middle of the sixteenth century, but faced with the almost unsurmountable difficulties of controlling hæmorrhage and sepsis, let alone the absence of anæsthesia, it is small wonder that the mortality remained high and even at the beginning of the nineteenth century caused Oslander to write :

“It cannot be denied that of the women who undergo Cæsarean section more than two-thirds die. . . . Before, then, undertaking this procedure one should allow the patient to draw up her will and grant her time to prepare herself for death.”

Apart from difficulties in controlling hæmorrhage at the time of operation due to the prevailing opinion that sutures could not be buried in the tissues owing to sepsis, there was the problem of the open uterine wound pouring infected lochia into the peritoneal cavity with inevitable peritonitis. Because of this there began to arise early in the nineteenth century, the idea of making an incision as low as possible in the uterus or even upper vagina to allow dependant drainage to take place; for, up to this time, the incision had been made in the upper segment. Advance was negligible, however, until the middle of the century when anæsthesia (Simpson), the cause of child-bed fever (Semelweis), and the use of antiseptics (Lister) made their outstanding contributions to surgery.

However, there was still the problem of lochia discharging into the abdomen and it was not until Porro of Padua in 1876 temporarily solved it by following Cæsarean section with subtotal hysterectomy and marsupializing the cervical stump in the abdominal wound. The Porro operation was a step forward, but obvious disadvantages made it short lived and it became outmoded when, in 1881 and 1882, Kehrer and then Säger devised satisfactory methods for suturing the uterine wound in two layers, muscle and peritoneum, using silk. In addition the uterine incision was transverse, adjacent to, if not in, the lower segment.

The scope of Cæsarean section became enormously enlarged and obstetricians appeared to vie with one another in devising new incisions in all parts of the uterus, including the posterior wall. But although the mortality dropped impressively to 5 per cent. and less, operations entailing incision of the upper segment were almost invariably fatal in cases infected before operation.

In 1906 Frank of Köhn devised an operation which not only employed transverse abdominal and lower segment incisions, but excluded the lower segment from the general peritoneal cavity. This he did by suturing the upper edge of the parietal to the upper edge of the visceral utero-vesical peritoneum. He closed the uterus in two layers with catgut. He is, moreover the first to have used Cæsarean section in the treatment of placenta prævia.

In the next few years the lower segment operation gained much popularity and became simplified by no longer being isolated from the general peritoneal cavity, and through the hands of such masters as Sellheim, Döderlein, Küstner, Latzko, Pfannenstiel, Krönig and Vogt the operation gradually assumed its modern appearance. In 1912 Krönig described what is virtually the existing operation and very soon afterwards it was first introduced into this country by Munro Kerr.

Extra-peritoneal Cæsarean section first devised in the early nineteenth century by Ritgen, and later used by Latzko, again became popular for the suspect and frankly infected case. Between the years 1930-40 Everard Williams in this country, Burns and later Waters in the U.S.A. published papers, but the operation offers little other than tedium and now has few if any protagonists.

Indications.

The indications for Cæsarean section today are here considered under the headings as *always*, *often* and *sometimes*.

It would be wrong, to assume that the compartments are even as well defined as this, for changing circumstances will often create the need for a change in tactics and each time Cæsarean section is considered, the indications in the particular case need to be carefully studied.

The trend today is for Cæsarean section to be used much more widely than heretofore, and the figure now is just over 6 per cent. In the main reasons for this increase are closely connected with a wish to diminish the risk to the fœtus and improve its chances of survival in such conditions as placenta prævia, accidental hæmorrhage, severe pre-eclampsia, diabetes mellitus, hæmolytic disease, prolapse of the cord and abnormal uterine action. Running parallel with this naturally is the greatly reduced risks in Cæsarean section from infection, brought about by the antibiotics. The conditions for which Cæsarean section is indicated will now be briefly considered.

Always.—Even conditions mentioned under this heading will sometimes be managed differently through force of circumstances.

Any gross obstruction to delivery such as *major pelvic contraction* and *impacted pelvic tumours* need no further comment, but sometimes serious organic stenosis of the cervix or vagina is just as impassable and necessitates abdominal delivery; the rare anterior sacculation of the uterus, arising from an impacted retroverted gravid uterus is also an indication.

Placenta Prævia of major degree is treated far more safely by Cæsarean section for the sake of both mother and baby. This has been the standard treatment for some years, but it is being used with encouraging results for many more cases of medium degree especially when the placenta prævia is posterior, and even some minor degrees, when there is another complicating factor. Both the extended use of Cæsarean section, now about 50-60 per cent., and the expectant management of placenta prævia have reduced the foetal mortality in this condition from over 40 per cent. to under 10 per cent. The maternal mortality is less than 1 per cent. which results from earlier diagnosis, admission to hospital and blood-transfusion.

When a properly conducted *trial labour in the previous pregnancy* has failed through real disproportion, the subsequent delivery of a mature fœtus should be by Cæsarean section. Sometimes a trial labour has to be terminated by Cæsarean section before there has been a real test, because of foetal distress and sometimes minor disproportion has been aggravated by the presence of a large postmature fœtus often with the occiput posterior. Commonly the test fails because of lack of progress, through abnormal uterine action. Cæsarean section would not necessarily be indicated subsequently, but each case must be separately reviewed.

It could be said that there is always an indication for Cæsarean section when a *trial labour is failing* for one reason or another, some of which have been mentioned already. When it becomes obvious that

in spite of effective contractions with the membranes ruptured and the cervix dilating well, there is still significant disproportion. Cæsarean section should not be delayed.

Cæsarean section is not always indicated in the case of the *elderly primigravida*, but when there is *an additional obstetric complication* such as minor disproportion, toxæmia, essential hypertension, antepartum hæmorrhage, slight postnatality or persistent malpresentation, there are very good grounds for choosing Cæsarean section.

A persistent breech presentation complicated by disproportion arising either from pelvic contraction or an over-size foetus (in excess of 8 lb.) is an indication for Cæsarean section. The size of the foetus is important when considering breech delivery especially in a primigravida, but unfortunately it is not always possible to recognize a big foetus antenatally. Because primary uterine inertia is often associated with the presence of a large foetus, it should act as a warning and call attention to the need for reassessing this aspect of the case, especially if it is a breech with extended legs, and if confirmed, Cæsarean section done without further delay.

Any patient with *a disease complicating pregnancy in which the stress of normal labour must be avoided* should be delivered by Cæsarean section. Such diseases as tuberculous, laryngitis, co-actation of the aorta, congenital cerebral aneurysm and recurrent detachment of the retina would all come under this heading. It will be noted that heart disease does not, but it does if labour is expected to be difficult.

A bad obstetric history when the patient has had several successive pregnancies with dead babies, is almost always a sufficient indication to deliver the next by Cæsarean section.

Prolapse of the cord when the cervix is not sufficiently dilated to allow immediate vaginal delivery is now treated by emergency Cæsarean section if the foetus is alive. While preparations are being made for the operation pressure should be kept off the cord by pushing the head or breech, whichever is presenting, into the iliac fossa or continuously elevating the presenting part with the gloved hand. The patient can be given oxygen to inhale and the cord should not be replaced in the uterus, but into the vagina if outside, to keep it warm and avoid spasm of its vessels.

Often.—Under this heading come some of the less certain decisions of the former group such as a bad obstetric history. In connexion with the problem of whether to deliver by Cæsarean section or not a useful guiding principle is that a patient can usually deal successfully with one obstetric abnormality if not too severe, but seldom two. A good example is heart disease; normal labour is usually managed

successfully, but would be avoided if difficulty is expected. Breech presentation with the suspicion of a big foetus, elderly primigravidæ and postmaturity are examples of some difficult situations created by two abnormalities when Cæsarean section is often indicated.

Diabetes mellitus is very often managed by delivery by Cæsarean section at 36-37 weeks, especially in a primigravida. Sometimes the induction of premature labour, more often in multiparæ, is preferred.

Progressive foetal distress in the first stage of labour can usually only be dealt with successfully by Cæsarean section if the degree of dilatation of the cervix will not permit vaginal delivery.

Abnormal uterine action resulting in hypertonic lower segment or cervical dystocia, is now being treated much more often by Cæsarean section with decidedly improved results.

Accidental antepartum hæmorrhage when it is concealed and extensive, kills the foetus before anything can be done to save it; but in cases in which the hæmorrhage is not so great the foetus is still alive. In these cases Cæsarean section offers the only reasonable chance for the foetus, if natural delivery is not imminent. Because hypofibrinogenæmia sometimes accompanies concealed accidental antepartum hæmorrhage the fibrinogen content of the patient's blood should be assessed before operation and made good if found deficient.

Mention has been already made of the extended use of Cæsarean section for more cases of *placenta prævia of lesser degree*. This is almost always to improve the chances of the foetus, for the risk from cord or placental compression is ever-present with vaginal methods of treatment.

Fulminating pre-eclamptic toxæmia may have to be treated by Cæsarean section if the chances of early vaginal delivery are small. The patient may not be in labour or labour may be weak and inert. The alternative at the present time is the use of hypotensive drugs temporarily to tide the patient over and ward off the onset of eclamptic fits until labour can be induced and the child delivered. Each case must be assessed according to its own merits.

Severe benign hypertension is a serious complication of pregnancy. Not only is pre-eclamptic toxæmia more likely to supervene but even if this is avoided the placenta is often badly infarcted, resulting in intra-uterine death of the foetus in late pregnancy. Infarction of lesser degree whilst not proving fatal during pregnancy may cause foetal death from increasing anoxia when labour begins. A sign that this may be more likely to happen is finding the foetus smaller than average.

It is not surprising therefore, that the uncertainty of labour is avoided in some cases, especially in older patients.

When the membranes have been ruptured artificially and labour does not begin, *failed surgical induction*, there is anxiety regarding the possibility of genital sepsis and of intra-uterine infection of the fœtus ; the longer the patient remains undelivered under these conditions the more likely are these complications to supervene. If labour has not begun in 48 hours it is common practice to begin antibiotic and chemotherapy (penicillin and sulphonamide) and at the same time to set up a continuous intravenous oxytocin infusion. This almost always stimulates the onset of labour, but sometimes it fails or there are other serious considerations ; Cæsarean section may have to be done. For example the age of the patient, or progressive toxæmia, may determine it, or infection may already have occurred ; the latter complication is always an indication for Cæsarean section. A persistently raised fœtal heart-rate may be the only, but significant, indication of infection in its early stages.

Finally *severe hæmolytic disease of the newly-born* may have resulted in the loss of one or more infants. When the husband is homozygous and Rhesus positive all subsequent pregnancies will be severely affected and the present tendency is to deliver the next fœtus at a time when it is mature enough to stand a chance, before irreversible damage from hæmolytic disease has taken place. This will sometimes necessitate delivery as early as 32 weeks and it is often felt that Cæsarean section at this stage is a more certain and less risky form of delivery for the immature fœtus affected by hæmolytic disease.

Sometimes.— In general it is true that Cæsarean section will sometimes be required for any obstetric abnormality if circumstances warrant it and just as some of the conditions under "often" featured in "always" when they were more serious, so they do in "sometimes" when less so. In particular would be found cases of *minor degrees of placenta prævia* when *bleeding persists* in spite of rupturing the membranes ; so too in *accidental hæmorrhage*. It depends on the amount of hæmorrhage and what other measures can be adopted.

Much the same applies to *toxæmia*, namely its severity and its response to treatment.

A *brow presentation* is sometimes to be treated by elective Cæsarean section if it is diagnosed in pregnancy. It is the correct method of treatment if the patient is an elderly primigravida. Sometimes Cæsarean section is indicated in the rare occurrence of *locked twins* if one or both are alive and cannot be disengaged.

Choice of Operation.

The standard operation of Cæsarean section to-day is usually the transperitoneal lower segment operation with a transverse incision in the uterus. It is a well-devised operation for these reasons :

(1) The incision is in the thinner and less vascular part of the uterus. In most cases, therefore, hæmorrhage is slight with little damage to the uterine musculature.

(2) The wound in this situation can be completely covered by the protective loose peritoneum over the lower segment. This provides a valuable safeguard against the formation of adhesions and intestinal obstruction ; it adds an additional protective barrier in suspect or infected cases.

(3) The operation although trans-peritoneal is in a cul-de-sac and is virtually isolated from the general peritoneal cavity. This is important in avoiding post-operative ileus in clean cases and peritonitis in infected cases.

(4) The relative tranquillity of the lower segment in the puerperium is thought to favour sound healing and so decrease the risk of subsequent rupture of the scar.

(5) These facts suggest that the transperitoneal lower segment operation is safer than classical Cæsarean section.

Choice of Time for Operating.—The best results are obtained from Cæsarean section when there is ample time to prepare the patient. for this reason the operator, when there is free choice, decides upon some day in the week preceding the expected date of labour. The uterus will contract and retract after the child is removed whether the patient is in labour or not. If, however, there is any uncertainty as to the duration of pregnancy, it is better to wait till labour begins before operating.

Preparation for the Operation.—The preparation of the patient is similar to that for any other major abdominal operation, except that a strong purgative should not be given the day before for fear of inducing labour, but an enema is given on the morning of the operation. Morphia is best avoided as premedication for the anæsthetic owing to its effect on the foetus.

The team is the same as that for any major operation, but in addition there must be an experienced midwife to take care of the baby with modern resuscitation equipment at hand. A catheter should be passed just before the patient is placed on the operating-table. It is essential

for the welfare of the child that the patient should not be under the influence of the anæsthetic longer than is absolutely necessary before the operation is begun. All preparations, therefore, must be made before the anæsthetist commences.

If more than average blood-loss is expected cross-matched blood must be ready in the theatre; in all other cases the patient's serum should be in the laboratory so that cross-matching can be done without delay if blood is unexpectedly needed.

Sterilization.

When Cæsarean section is performed for some chronic progressive disease and a decision has been authoritatively made that further pregnancy is to be avoided, sterilization after Cæsarean section is probably justifiable. The expert on whose second opinion the operation is being advised should give his advice in writing and sign it. The significance of the operation should be carefully explained to both the patient and her husband and both should sign consent. It is scarcely ever withheld.

Sometimes the operation is performed because the patient has a contracted pelvis and wishes to avoid further Cæsarean sections, but it is usual not to consider sterilization until she has had at least two Cæsarean sections. The operation is justified on the grounds of the increased risk of Cæsarean section over natural delivery, but its final and conclusive negation of future childbearing should be carefully explained.

In such cases when the operation is not being done on purely medical grounds, *e.g.* after the second Cæsarean section, it is wise to point out that babies lead a somewhat precarious existence for some time after birth, and it is not possible to guarantee it will survive and thrive. Sterilization as a planned operation when the baby is between six and twelve months old is a wiser procedure.

Finally, Cæsarean section is never done merely in order to sterilize a patient. Such a procedure is never justifiable. If sterilization has been recommended for a patient with heart disease, unsuitable for cardiac surgery, the operation is best done about a week after normal delivery while the uterus is still partly an abdominal organ. It can then be very easily done under local anæsthesia combined with sedative drugs; but breathing-exercises and leg-exercises should be encouraged after operation to lessen the risk from embolism. If local anæsthetics are being used the meso-salpinx as well as the abdominal wall must be infiltrated.

The most certain method of tubal sterilization is offered by excision of the interstitial part of each Fallopian tube, but the operation is not devoid of risk from hæmorrhage.

A simpler procedure is to ligate each tube with linen thread as close to the uterine cornu as possible and then to ligate the ampullary portion and excise it.

Anæsthesia for Cæsarean Section.

In choosing the most suitable form of anæsthesia for Cæsarean section the effect of the drug on the foetus must be considered as well as the practice and experience of the anæsthetist. If the latter is limited, then the anæsthetic agent with which he is most familiar should be chosen. One of the most important aspects of the technique is the maintenance of a clear airway to avoid cyanosis, and the avoidance of aspiration of gastric contents. The suggestions put forward with regard to the safeguards to be taken with inhalation anæsthesia for forceps delivery (p. 507) are just as important for Cæsarean section.

Some form of inhalation anæsthesia is most commonly used. Nitrous oxide and oxygen, with trilene, ether, or fluothane, are often chosen for safety. When the patient is not in labour, nor the head deep in the pelvis such an anæsthetic can be light and the foetus can be delivered relatively quickly before it absorbs significant amounts of anæsthetic. If on the other hand more relaxation than light anæsthesia can offer is required, either more of the volatile agent, must be added with possible adverse effects on the foetus or, better than this, regional infiltration of the abdominal wall with local anæsthetic before inhalation anæsthesia is begun.

The most popular anæsthetic drugs are pentothal, gas and oxygen, and scoline. They require a skilled anæsthetist but this is an added advantage. There is no danger to the foetus from pentothal, and scoline does not cross the placental barrier, but it increases uterine tone when extra relaxation is needed as in elevating a head from the pelvis.

Spinal anæsthesia is not employed so much as its theoretical advantages indicate.

Local anæsthesia for Cæsarean section is ideal for the foetus but it does not suit all patients.

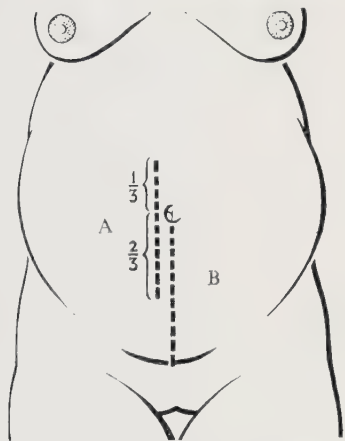


FIG. 228.—CÆSAREAN SECTION INCISIONS.

(A) CLASSICAL INCISION. One third of its extent is above umbilical level and the remainder below.

(B) LOWER SEGMENT INCISION. This incision is entirely below umbilicus.

The Lower Segment Operation

The peritoneal cavity is opened by a vertical incision from the umbilicus to just above the symphysis pubis. A hand is passed into the peritoneal cavity to confirm that the uterus is not unduly dextro-rotated. A light pack, with attached tape and moistened in saline is tucked into each iliac fossa to prevent unnecessary spilling of blood and liquor (a possible cause of post-operative distension); a de Lee's retractor

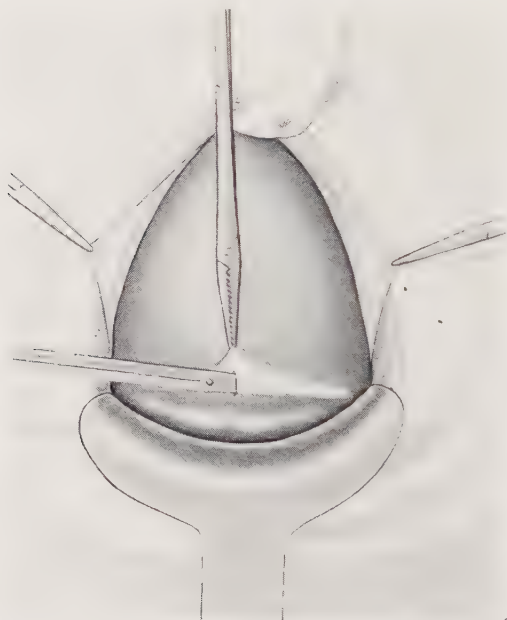


FIG. 229.—LOWER SEGMENT CÆSAREAN SECTION.

The loose peritoneum over the lower segment is being lifted up before it is incised.

is inserted into the lower end of the wound. The peritoneum of the utero-vesical pouch is divided transversely near its upper limit for about $3\frac{1}{2}$ inches, and the bladder is gently pushed down. The de Lee's retractor is now slipped behind the bladder and loose flap of peritoneum to hold them forwards and expose the lower segment. A transverse incision about 1 inch long is made in the mid-line of the lower segment and deepened until the membranes bulge, but the amniotic sac, if possible, should be kept intact at this stage. Two index fingers are slipped into the incision by which it is split transversely to an extent of about $3\frac{1}{2}$ inches. The membranes are ruptured and the head is delivered by slipping a hand beneath it and applying first one blade of Wrigley's

forceps and then the other. The head should always be delivered gently ; if the patient is in strong labour and the head is deep in the pelvis or wedged in the brim, a good deal of help can be gained by the assistant lifting up the shoulders during head elevation and by the table being given some degrees of Trendelenberg tilt. Very occasionally an assistant may be needed to push the head up from below. As the head is delivered the anæsthetist injects 0·25 mg. of ergometrin into a convenient vein of the patient's hand or arm, sometimes combined with



FIG. 230.—LOWER SEGMENT CÆSAREAN SECTION.

The lower segment is being exposed and a short incision made through it down to the membranes.

morphia. The shoulders are carefully delivered, being eased out of the wound to avoid dangerous splitting of the wound's lateral extremities. The fœtus is held head downwards to drain it of liquor ; the mouth and pharynx are cleared with the finger. The cord is clamped and divided and the infant is handed over to the care of the waiting midwife.

The placenta soon separates and it is delivered through the wound. The uterus is explored to confirm the complete expulsion of the placenta and a finger is passed down through the cervix for drainage.

The uterine incision is sutured in the usual way ; the suture material varying according to the idiosyncrasy of the surgeon.

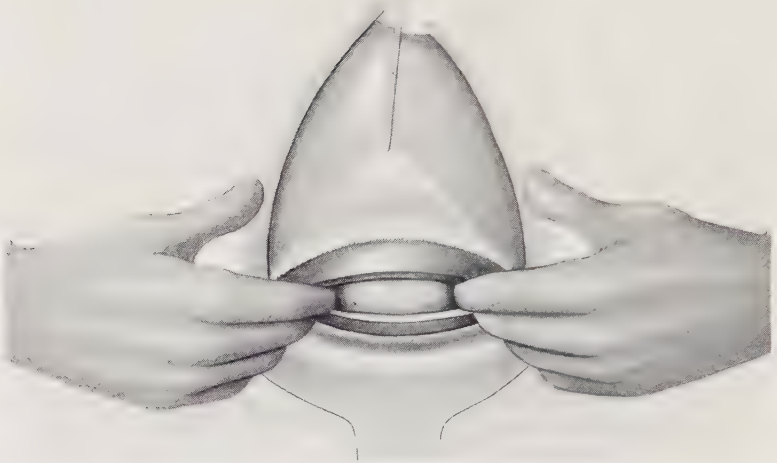


FIG. 231.—LOWER SEGMENT CÆSAREAN SECTION.

The incision in the lower segment is being enlarged by finger traction.

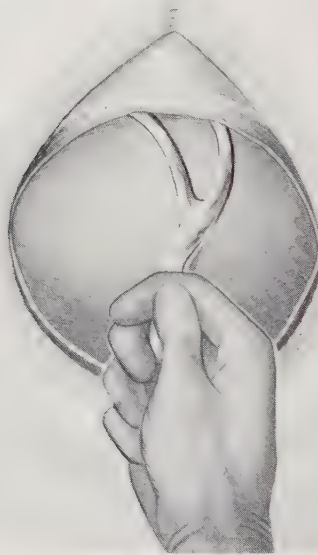


FIG. 232.—LOWER SEGMENT CÆSAREAN SECTION.

Wrigley's short forceps have been applied to the head which is being lifted through the lower segment incision.

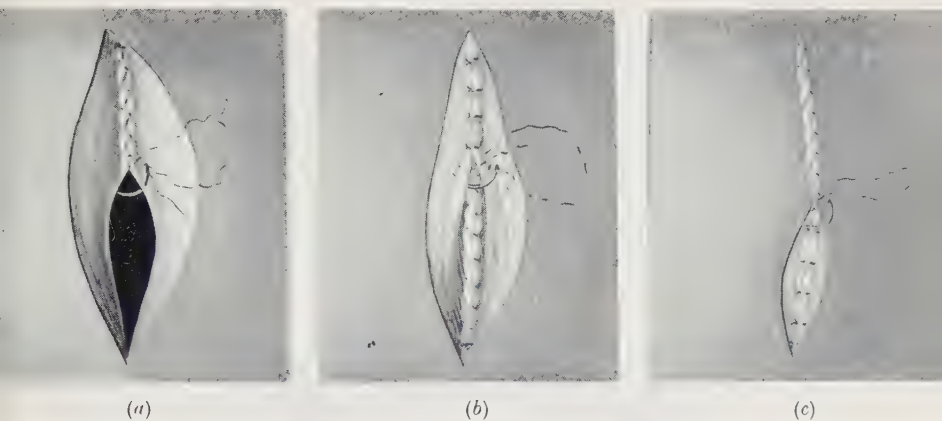


FIG. 233.—LOWER SEGMENT CÆSAREAN SECTION.

- (a) Inserting the continuous deciduo-muscular cat-gut suture.
- (b) Inserting the interrupted musculo-fascial cat-gut suture.
- (c) Inserting the continuous peritoneal cat-gut suture.



FIG. 234.—CLASSICAL CÆSAREAN SECTION.

- (a) Inserting the continuous deciduo-muscular cat-gut suture.
- (b) Inserting the interrupted non-absorbable (nylon) muscular suture.
- (c) Inserting the continuous peritoneal cat-gut suture.

Classical Cæsarean Section

The incision in the abdominal wall should be made either to one side of the mid-line or in the mid-line, is about 6 inches long, and is placed so that one third is above the level of the umbilicus and two thirds below. After the peritoneal cavity has been opened a hand is introduced to cant the uterus back evenly from its dextro-rotated position.



FIG. 235.—CLASSICAL CÆSAREAN SECTION.
Delivering the child.

The uterus is incised vertically in the mid-line of the anterior wall of the upper uterine segment, the membranes are ruptured and the foetus is then delivered through the wound.

The incision in the uterus is sutured with two layers of cat-gut and the abdomen is closed in the ordinary way.

Post-operative Care. —The patient who has had a Cæsarean section is looked after in the same way as any patient who has had a major abdominal operation.

The Dangers of Cæsarean Section.

These can best be discussed under the headings immediate and remote, but closely concerned with both will be the circumstances of the operation, the reason for the operation, the fitness of the patient before and during labour, previous attempts at delivery, the skill of the operator and anæsthetist and finally the type of operation.

The risks in lower segment Cæsarean section performed as a planned operation under good conditions by a competent operator aided by a skilful anæsthetist, are very low as a major operative procedure, being approximately 0·3 per cent.

Immediate.—The risks, entailed include only those during the operation and the immediate post-operative interval.

Blood must always be readily available for patients undergoing Cæsarean section.

Sufficient emphasis has already been given to the importance of an operating-table which can rapidly be tilted in order to avoid the inhalation of gastric contents. Infection in the planned operation has been reduced to negligible figures.

Pulmonary embolism occasionally occurs after Cæsarean section, more particularly in obese and anæmic patients. Anti-coagulant therapy undoubtedly has played a part in the more effective management of these cases, but careful dieting and making good iron or other blood-deficiency in pregnancy could be even more valuable prophylactically. When Cæsarean section is contemplated in an emergency, anæmia and shock should be treated by blood-transfusion.

Remote.—Two dangers fall into this category; (i) Intestinal obstruction (ii) Rupture of the uterine scar. Now that the lower segment operation is the standard procedure intestinal obstruction is rare. But it may occur in a subsequent pregnancy owing to the stretching of adhesions by the enlarging uterus.

Rupture of the scar is relatively a rare complication in a subsequent pregnancy or labour. The classical Cæsarean section scar is said to be more likely to rupture than the lower segment one. Infection makes rupture much more likely after either operation. But whether infected or not any patient who has had a Cæsarean section should be under the care of an obstetrician and be in hospital for all subsequent deliveries.

Dangers to the Fœtus.—The operation carries little risk for the fœtus. Nevertheless, Cæsarean section has an inherent very small hazard. (i) The operation requires an anæsthetic and if this is something other than local the fœtus may suffer from anoxia as a result of regurgitation or of progressive uterine tone. (ii) There is something lacking in

Cæsarean section as a method of delivery, the infant does not always begin to breathe, or if it begins, breathes poorly. This state of affairs is more often seen in the premature infant especially in diabetes; hyaline membrane disease is not an uncommon finding. Sometimes when Cæsarean section is planned near term, for disproportion, the expected date of delivery may not be correct and the operation done at the 35th rather than the 39th week. For this reason some obstetricians operate only after the onset of labour. (iii) It is possible to cause serious intracranial damage by delivering the head without proper care either up from the pelvis or through too small a uterine incision. It is therefore unwise to promise the birth of a living thriving baby by Cæsarean section even when carried out as a planned operation.

Cæsarean Hysterectomy

This operation is rarely indicated, although it carries very little risk. The indications may arise from such conditions as :—

(1) Fibroids. When the patient's age and wishes are against further pregnancies multiple or interstitial fibroids are best treated by hysterectomy.

(2) Uncontrollable hæmorrhage through either operative trauma or uterine atony. These complications have been already discussed. Hysterectomy is indicated. It is very seldom indicated in young patients. In cases of concealed, or largely concealed, accidental hæmorrhage serious bleeding may occur from the abdominal wound as well as from the uterus. In such circumstances it may well be due to hypofibrinogenæmia when fibrinogen-replacement is indicated rather than hysterectomy.

(3) Sepsis. It is doubtful if hysterectomy is ever more than occasionally justifiable for severe infection now that antibacterial control is so effective. In cases of infected necrotic fibroids Cæsarean section should be performed.

(4) Placenta accreta may have to be treated by Cæsarean hysterectomy. It is certainly best if the condition is more than of minimal degree and the woman parous.

(5) Rupture of the uterus. Hysterectomy may be indicated after rupture of the uterus if there is serious infection as well or if the rupture is so extensive that repair is either not practical or would leave a dangerously weak scar.

(6) Previous Cæsarean sections. This seldom arises, but, if sterilization is the alternative, hysterectomy may be preferred when the patient is of an age that dysfunctional menorrhagia already is present.

(7) Malignant disease. This may be ovarian when removal of the uterus and both ovaries is indicated ; or it may be carcinoma of the cervix, when Wertheim's hysterectomy is the correct operative procedure.

Technique.—This differs little from the standard procedure on the non-postpartum case except that the tissues, especially the connective tissue, is softer and more plastic. The steps of the operation are exactly the same but when the patient has been in labour for long the cervix and vagina may be indistinguishable from one another. When so confronted the fingers can if necessary be passed through the lower segment wound to help delineate the boundaries.

CHAPTER XLII

THE THERAPEUTIC TERMINATION OF PREGNANCY

PREGNANCY may be terminated:—

1. Before the child is viable, induction of abortion.
2. When the child is viable, induction of labour.

INDUCTION OF ABORTION

The law in Britain relating to criminal abortion makes it absolutely clear that the induction of abortion or miscarriage (nowadays the words are regarded as synonymous) is always illegal. Moreover, the law specifically states that attempts to induce abortion, even if the woman is not pregnant, are regarded as being in precisely the same category as if she were with child. Furthermore, the attempted induction of abortion by the administration of drugs is legally regarded in the same light as when surgical means are employed. Any person, including the pregnant woman herself, who attempts to procure abortion by any means whatsoever “. . . shall be guilty of felony, and being convicted thereof shall be liable, at the Discretion of the Court, to be kept in Penal Servitude for Life or for any Term not less than Three Years . . .”

It must be noted that there are no reservations. It necessarily follows that every time a pregnancy is terminated a felonious act of the greatest magnitude is committed, and the person committing it renders himself liable to dire penalty.

None-the-less, ever since the Criminal Abortion Act of 1861, the induction of abortion has been generally recognized as legitimate in cases in which serious illness of the expectant mother is endangering her life.

As the immediate or prospective danger to the mother cannot be accurately estimated, many cases will occur in which a correct judgment is difficult. It is incumbent on every medical practitioner to obtain two opinions, preferably from consultants who have specialized in the condition under consideration, for his own protection, since he may have to meet the suspicion of illegal abortion. The induction of abortion should never be carried out by a general practitioner, the operation should only be done in hospital by a consultant.

The pressure on the general practitioner may become so strong that he may be persuaded to perform an abortion against his better judgment, and before he is convinced that all other measures have failed. For instance, in a severe case of vomiting of pregnancy, when the patient is nervous, irritable, and out of control. Although her urine is normal, her pulse-rate scarcely raised, her tongue moist, and there is no evidence of marked loss of flesh, both she and her relatives may insist that pregnancy must be terminated or she will die. Moreover in many cases the patient, for economic or other reasons, is desirous of having her pregnancy terminated. The question must be settled on purely medical grounds, and every effort must be made to check the patient's story by observation, for she may exaggerate every symptom, and produce new ones if the old ones fail to give the looked-for result. In such cases if the patient is isolated from her friends, properly nursed and kept under control, she will probably soon be cured.

Some practitioners are ready to forbid a woman to have any more children because something went wrong during a former pregnancy or labour, and to recommend the induction of abortion, even repeatedly, if pregnancy occurs. Such advice should almost never be given.

Indications:—

1. Missed abortion.
2. Hydatidiform mole.
3. Hyperemesis gravidarum.
4. Cardiac disease.
5. Pulmonary tuberculosis.
6. Chronic nephritis.
7. Mental illness.

The first two indications call for no comment ; the ovum is already dead and evacuation of the uterus is simply anticipating an inevitable result.

Hyperemesis gravidarum.—With few exceptions this complication can be arrested with early and adequate treatment in hospital. If, in spite of correct treatment, the patient's condition deteriorates as evidenced by a pulse-rate persistently over 100, or by the appearance of jaundice, termination of the pregnancy is urgently indicated.

Cardiac disease.—In severe cases (Group 3) in which either congestive failure is present, or when there are marked signs of cardiac distress after only a very limited effort, termination of pregnancy is indicated if the case is seen before the 16th week. After this period the risks

of interference are probably greater than those of allowing the pregnancy to go to term. With recent advances in cardiac surgery, particularly mitral valvotomy, a number of cases in which the induction of abortion would have been advised are now able safely to continue to term after the cardiac condition has been improved by operation.

Pulmonary tuberculosis.—It was believed that pregnancy had a very marked adverse effect on pulmonary tuberculosis, termination being frequently advised in cases with active lesions or with lesions which had recently become quiescent.

Recent work shows that, in fact, pregnancy has little effect on the course of the disease with adequate supervision and treatment throughout pregnancy, labour and the puerperium. This calls for the closest co-operation between the physician, the obstetrician and the local health authority so that the patient may be provided with adequate help and continuity of treatment and supervision on her return home.

In the past few years there has been a marked fall in the number of cases in which abortion has been induced; the operation is mainly confined to patients with lesions which have recently become quiescent under treatment.

Chronic nephritis.—Termination may be indicated in the severe case of chronic nephritis because the patient runs grave risks of uræmia, albuminuric retinitis, accidental hæmorrhage and cerebral hæmorrhage: the child may also die *in utero*.

Mental illness. Termination of pregnancy on the grounds of mental illness is one of the most difficult problems in obstetric practice. While there are unquestionably psychiatric illnesses which justify termination, it must always be remembered that any woman, pregnant against her wish, is under very great mental strain and is often prepared to go to any lengths to get rid of the pregnancy. Her position is frequently made worse by her social circumstances in that she may be unmarried. Her genuine distress may closely simulate or actually precipitate psychiatric illness and threats of suicide are not uncommon.

The opinion of a reputable psychiatric consultant must always be obtained, in writing, before considering the induction of abortion.

Should it be decided that the pregnancy is to be terminated the written consent of both the wife and her husband must be obtained. If the mother is a minor and unmarried both her parents should give written consent.

Rubella.—The association between maternal rubella and a congenitally malformed child is now widely known; the most severe types being deaf mutism, mental deficiency, cataract and congenital cardiac lesions. It is natural that women, who have contracted this illness during pregnancy, should be greatly concerned about the possible effect

that it may have on the unborn child ; they generally seek medical advice, in some cases requesting that the pregnancy should be terminated.

This is a very difficult problem since the risk of a malformed child cannot be accurately assessed ; it is known to vary with the type of infection, the estimates ranging from 15 to 30 per cent. There is no doubt that the risk of a malformation is greatest during the first 4 months of pregnancy, after the 16th week the risk is small and can be ignored.

It should be remembered that the general incidence of congenital malformations is about 2 per cent. of all births, and that only about 25 per cent. of congenitally malformed children will be seriously incapacitated by their particular defect. There is no general consensus of opinion on the desirability of termination of pregnancy in these circumstances since there are so many unknown factors, and it must be remembered that it is illegal to terminate a pregnancy merely to avoid a deformed child.

If termination be considered, it is necessary to show that worry about the probable abnormality of the unborn child is adversely affecting the health of the mother.

Methods

The method to be employed will depend on the nature of the disease for which the abortion is being induced, and the date to which the pregnancy has advanced.

1. Dilatation of the cervix and evacuation of the uterus *per vaginam*.
2. Abdominal hysterotomy.

Dilatation of the Cervix.—This is the best method of emptying the uterus rapidly, provided that it is done earlier than the 12th week.

Operation.—The patient is anæsthetized and placed in the lithotomy position. The vagina is then swabbed with antiseptic solution after which a weighted speculum is inserted and the cervix is pulled down by a volsellum.

The cervical canal is carefully dilated. The tip of each dilator need not be passed far into the cavity of the uterus ; it should be passed so that it just dilates the internal os. If this is done the amount of separation of the ovum from the uterine wall produced by the introduction of each successive dilator will be enormously decreased, and as a result the bleeding during this stage of the operation will be negligible. Dilatation is continued up to No. 16 or No. 18 dilator. A ring or ovum forceps is then passed gently through the cervix. As soon as the instrument is inside the cavity of the uterus,

it is slowly opened to its full extent, and then slowly closed. Withdrawal must be slow and gentle. When all the products of conception have been evacuated 0.25 mg. of ergometrine is injected intravenously by the anaesthetist and within a few minutes the bleeding will stop. Persistent bleeding generally indicates that some portion of the ovum still remains in the uterus, and calls for further exploration of the uterine cavity.

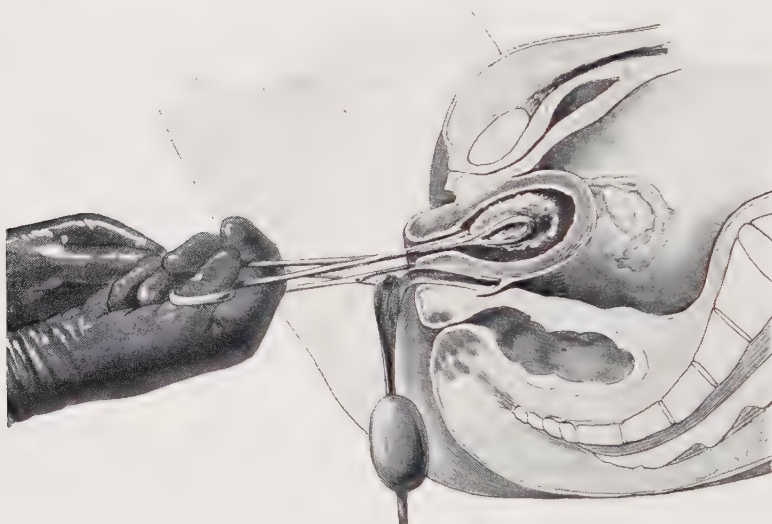


FIG. 236.—REMOVAL OF THE DETACHED OVUM WITH OVUM FORCEPS.

It is important to appreciate that this operation is full of dangers, and that unless the operator is expert and uses the greatest care he can quite easily perforate the uterus or infect the patient. Hæmorrhage is often very considerable and it may occasionally be necessary to pack the uterine cavity with ribbon gauze and give a blood-transfusion.

After the end of the 12th week of pregnancy, if the cervix is closed, it is a matter of very considerable difficulty immediately to empty the uterus by the vaginal route. At this period of pregnancy the head of the child is of such a size that it is only rarely that the cervix can be dilated to a degree which will allow of its easy extraction. It is probable that the cervix will be dangerously lacerated in the region of the internal os in attempts to dilate it sufficiently, or else the head of the foetus will become detached from its body. Severe hæmorrhage may accompany this procedure.

In those cases in which termination of pregnancy is indicated after the 12th week of gestation, the ovum should be removed by abdominal hysterotomy.

Abdominal Hysterotomy.—This operation consisting of a miniature classical Cæsarean section can be done at any stage of pregnancy, and sterilization can be performed at the same time, if indicated.

The abdomen is opened by a midline sub-umbilical incision. The uterus is lifted up through the incision and the rest of the peritoneal cavity excluded from the operation area by one or two large abdominal packs. At this stage ergometrine, 0·25 mg., should be injected direct into the uterine muscle to diminish the amount of bleeding. A vertical incision is now made in the anterior surface of the body of the uterus through the whole thickness of the muscle, and the fœtus, placenta and membranes are removed; if the pregnancy is in an early stage it is generally possible to deliver the gestation sac and placenta intact through the incision after gentle separation with a finger.

If sterilization is indicated, it can be performed by ligature or excision of the Fallopian tubes before the abdomen is closed.

INDUCTION OF LABOUR

Indications.

1. Toxæmia of pregnancy
2. Postmaturity
3. Breech presentation in primigravidæ
4. Cephalo-pelvic disproportion
5. Anticipated death of the fœtus
6. Antepartum hæmorrhage
7. Hydramnios

The list given above contains the commonest indications for the induction of labour, but in special circumstances it is employed in a large number of other conditions.

Toxæmia of pregnancy.—This is the commonest indication for the induction of premature labour.

Postmaturity.—If it is certain that a pregnancy has been prolonged to the 42nd week it is generally considered advisable, in the interest of the fœtus, that labour should be induced.

Breech presentation.—When attempts at external cephalic version have failed, induction of labour is sometimes advocated about the 38th week to obtain an easier delivery of the after-coming head. This form of treatment should be considered in a primigravida with an average but not capacious pelvis, or when the baby seems to be above average size, and in multiparæ whose babies have been getting progressively larger with each pregnancy. In such cases rupture of the hind waters is the method of choice as it excludes the risk of prolapse of the cord and some of the liquor is retained.

Disproportion. Trial of labour is the method of choice for the treatment of disproportion in a first labour, but in particular cases in which the first labour ended with a difficult forceps delivery on account of a moderate degree of disproportion, induction of labour at the 38th week can be considered in subsequent pregnancies.

Anticipated death of the foetus.—Intra-uterine death of the foetus may be associated with essential hypertension, diabetes and *Rhesus* incompatibility but in many cases no cause can be found. When there is a history of foetal death in a previous pregnancy it is reasonable to consider the induction of labour soon after the 36th week in order to obtain a live child.

If intra-uterine death has occurred labour will eventually begin. However, the knowledge that the baby is dead is most distressing to the mother and since the presence of a dead foetus *in utero* for a long period of time may very occasionally give rise to afibrinogenæmia it is justifiable to induce labour at the end of a week from the time of the intra-uterine death.

Medical induction with a pitocin drip is almost always successful in causing the onset of labour; rupture of the membranes is to be avoided owing to the risk that the macerated foetus may become infected.

Antepartum hæmorrhage.—Induction of labour by rupture of the membranes is a method of treating accidental hæmorrhage and placenta prævia, except for stages 3 and 4.

Hydramnios.—Induction of labour by rupture of the membranes is frequently indicated in this condition, particularly when it is associated with gross foetal abnormality such as anencephaly.

Methods

The methods of induction of labour are divided into two types, (a) medical when drugs are used to stimulate uterine contractions, and (b) surgical when physical stimulation is applied direct to the cervix and lower uterine segment by rupturing the membranes. It is most important that induction of labour should be carried out only for those cases in which it is considered that the delivery is a matter of urgency, either for the mother or the child. In no circumstances should it be undertaken for the convenience of the patient or her medical attendant. Once induction is instigated it must be carried to its logical conclusion and should both medical and surgical induction fail it will be necessary to proceed to Cæsarean section.

Medical Induction of Labour

Medical induction of labour may be tried in any of the conditions for which surgical induction is indicated provided that the indications

are not urgent and the patient near term. It often fails, and is therefore contra-indicated in urgent cases in which a speedy onset of labour is essential. Its great advantage is that it does not carry any risks of infection to either the mother or child. The simplest method is a hot bath followed by an enema, but this will only succeed if labour is about to begin. The giving of castor oil has now been discontinued since the violent purgation that it produces exhausts the patient and adds nothing to the success of the induction.

The drug most commonly used for the medical induction of labour is pitocin. For a number of years it has been given by intramuscular injection in divided doses of 2 units at half hourly intervals up to a maximum of six doses. Administered in this manner it can be dangerous because it may produce violent uterine contractions of long duration which may cause intra-uterine death of the foetus from asphyxia or even rupture of the uterus, and in addition there is evidence that in some cases a pitocin-induction of this type may result in inco-ordinate action of the uterus in the ensuing labour.

Pitocin used for induction of labour should be given by the intravenous drip method. This has the advantage that the drug acts continuously and the dose can be accurately regulated to the requirements of the patient. Experience has shown that a very small dose, *e.g.* $2\frac{1}{2}$ units given over 2 or 3 hours is sufficient to initiate labour.



FIG. 237. PITOCIN DRIP.

Pitocin drip. The solution contains two and half units of pitocin in one litre of 5 per cent. glucose saline ; this is injected initially at 10 drops per minute. The drip is set up as shown in the illustration with another containing one litre of 5 per cent. glucose saline, and the two are connected together with a Y-connexion close to the needle inserted into the patient's vein. The drip is started at a rate of 10 drops per minute. It can only be done in hospital as it is essential that the patient should be under constant observation during the administration of the drip and that a chart be kept of the strength and time interval of the uterine contractions ; the foetal heart should be auscultated at 15-minute intervals. If the contractions are weak and irregular the rate of the drip is increased until satisfactory contractions occur. When the contractions are regular the pitocin solution can be turned off and the drip continued with the plain glucose saline solution ; but if the contractions pass off the pitocin may be recommenced. Provided the patient is at, or past, term labour generally commences with the administration of $2\frac{1}{2}$ units of pitocin, but if it does not a stronger solution of 5 units pitocin to the litre of glucose saline may be tried with the same precautions.

Medical induction, as described above, is a trying procedure for the mother and repeated attempts to induce labour by medical means at intervals of a few days will leave the patient exhausted in mind and body, hence medical induction should be contemplated only when it is understood that its failure will be followed by surgical induction.

Surgical Induction of Labour

Artificial rupture of the membranes.—This is the method of choice. Either the forewaters, hindwaters, or both may be ruptured.

Low rupture of the membranes—This is the simplest and best method. The loss of the bag of forewaters is not now considered to have any adverse effect on the dilatation of the cervix, and predisposes to an easier onset and quicker labour than when it remains intact. There is a small risk of prolapse of the umbilical cord if the presenting part is not engaged in the pelvis.

High rupture of the membranes.—This method calls for more skill than simple low rupture. It does not predispose to prolapse of the cord but there is a risk of partial separation of the placenta and the onset of labour is generally delayed for longer than if the forewaters are ruptured.

Technique. Whichever method is employed the preliminary steps are the same. The operation should only be performed either

in the operating theatre or the labour ward. An anæsthetic is essential for a primigravida but may not be required in a parous patient with a capacious vagina and open cervix. The patient is placed in the lithotomy position and draped with sterile towels, after swabbing the vulva with antiseptic solution. The operator, wearing sterile gloves, gown and mask, now makes a vaginal examination to confirm the presentation of the fœtus. A finger is passed through the cervical canal, and is then swept round inside the uterus to separate the membranes from the lower uterine segment over as wide an area as can be reached. This separation of the membranes off the lower segment is as important a factor in inducing labour as the actual rupture of the membranes; generally it is followed by a little bleeding.

In parous patients and in primigravidae at or after term the cervix is soft and a finger can easily be passed through the cervical canal, but in a primigravida before term the cervix is relatively hard and may occasionally require dilatation before a finger can be passed into the uterus.



FIG. 238.—THE DREW-SMYTHE CATHETER.

[John Bell & Croyden.]

Low rupture of the membranes.—This is done by passing the blades of a pair of Kocher's artery forceps along the fingers up through the cervical canal, seizing the bag of waters with the tips of the forceps and tearing it. If the head is not deeply engaged in the pelvis an assistant should push the head in from above as it not only facilitates rupture of the membranes by making the bag of forewaters tense, but also diminishes the risk of prolapse of the cord. Once the membranes have been ruptured it is essential to let out as much liquor as possible and if the head is well down in the pelvis it may be necessary to push it up a little to allow some of the hindwaters to escape.

High rupture of the membranes.—This method was introduced with the object of keeping the bag of forewaters intact, but is seldom used now as it always carries the risk of partial separation of the placenta.

A Drew-Smythe catheter is introduced through the cervix passed round the head outside the membranes, and the hindwaters are tapped by means of a stilette within the catheter. When the head is high it is sometimes an advantage to combine both types of rupture doing the

high rupture first to allow the head to descend into the pelvis without risk of prolapse of the cord, and then to rupture the bag of forewaters.

After rupture of the membranes labour usually begins within 24 hours; the early onset of contractions depends more on the parity of the patient and the maturity of the pregnancy than on the amount of liquor removed. If the contractions do not commence within 24 hours a pitocin drip should be given to supplement the surgical induction and this is almost always successful. In the cases in which labour has not commenced within 72 hours of the surgical induction followed by a pitocin drip, the question of Cæsarean section must be considered in the interests of both mother and child.

Prognosis.—So far as the mother is concerned, any manipulation, such as those described, is associated with a potential risk of infection. The longer the interval between the rupture of the membranes and delivery the greater the risk. The child also runs a risk of intra-uterine infection, particularly of the lungs, and may die either *in utero* or in the neo-natal period from pneumonia. The other risk to the child is that of prematurity, and is therefore high if the induction has to be performed before the 36th week, *i.e.*, in certain cases of toxæmia and *rhesus* incompatibility.

CHAPTER XLIII

PUERPERAL PYREXIA

By statutory definition the term puerperal pyrexia denotes a rise of temperature to or above 100·4° F. (38° C.) from any cause within 14 days of labour or miscarriage. It therefore includes all cases of puerperal sepsis. It is the duty of the practitioner to notify all such cases to the local medical officer of health.

The causes of puerperal pyrexia are :

1. Genital tract infection or puerperal sepsis.
2. Urinary infection.
3. Breast infection.
4. Thrombo-phlebitis.
5. Respiratory tract infection.
6. Other causes of pyrexia.

With the decreased incidence of genital tract infections, urinary infections are now the commonest cause of puerperal pyrexia. Recent investigations into the causes of puerperal pyrexia have shown that in rather more than 15 per cent. of the cases no cause could be found for the rise in temperature on either clinical or bacteriological examination. In these cases the temperature returns to normal without any treatment, the rest of the puerperium being uncomplicated.

1. Genital Tract Infection (Puerperal fever or puerperal sepsis)

Known as "childbed fever" this was the scourge of the first obstetric hospitals where the mortality from it was so great that any patient was fortunate who survived her stay in hospital. It was not realized until the middle of the nineteenth century that the cause of epidemic puerperal infection was due to lack of cleanliness on the part of the attendants who carried the infection from one patient to another. Antiseptics and later asepsis were introduced into obstetric practice and quickly diminished the risks of genital tract infection, but it still remained the most important cause of maternal mortality.

In 1935-36 the sulphonamide group of drugs was discovered and produced dramatic results in the treatment of the most lethal type of infection due to the hæmolytic streptococcus. Penicillin and the other antibiotic drugs have still further reduced the dangers of infection, the great majority of the cases occurring to-day being of the mild

localized type. Puerperal sepsis, once the most important cause of maternal mortality, now accounts for only 4 per cent. of all deaths.

Although the incidence and severity of genital tract infection has fallen so dramatically in recent years there is danger in complacency. New strains of organisms, particularly the staphylococcus, resistant to the commonly used drugs appear from time to time and cause outbreaks of serious infection. It is only by strict attention to asepsis and the maintenance of a high standard of obstetric practice that they can be controlled.

Ætiology

When the placenta separates from the uterine wall, a raw area is left which may be regarded as an extensive but superficial wound. Lower down the birth-canal other wounds may be left as a result of delivery; thus the cervix is not infrequently torn, the fourchette is invariably torn in first confinements, and sometimes the perineum also. These wounds, the result of labour, may become infected like wounds anywhere else, and the symptoms and physical signs resulting therefrom constitute the disease which was known in the past as childbed or puerperal fever, but is nowadays termed puerperal sepsis.

Any pathogenic organism, if implanted in a wound may grow and multiply, and the wounds left by labour are no exception to this rule.

In practice it is found that in genital tract infection only a few organisms are at all commonly found, namely :

- Anærobic streptococcus
- Staphylococcus aureus
- Non-hæmolytic streptococcus
- Hæmolytic streptococcus
- Streptococcus viridans
- Escherichia coli
- Clostridium Welchii

Hæmolytic streptococci and staphylococci tend to produce the most serious infections, and escherichia coli the mildest.

Anærobic streptococcus. -The most frequent cause of infection which is generally localized and of the mild type.

Staphylococcus aureus is often found in vaginal swabs taken from mild cases with a mixed infection, but it is probable that in this type of case the organism is a saprophyte and not the cause of the infection. However, the staphylococcus has replaced the hæmolytic streptococcus as the most lethal because it has produced a number of strains resistant to the antibiotics and these are to-day the cause of a number of fatal cases of infection particularly after abortion.

Non-hæmolytic streptococci : give rise to a mild type of infection.

Hæmolytic streptococci are divided into nine groups A to K (Lancefield classification) and of these groups A is most commonly found in serious and fatal cases. Fortunately it is still sensitive to penicillin and the sulphonamides and no longer the serious problem that it was in the past.

Streptococcus viridans also gives rise to a mild type of genital tract infection, but is of particular importance in patients with rheumatic heart disease as it may cause acute endocarditis.

Escherichia coli is an infrequent cause of infection, which is generally localized to lacerations of the vagina and perineum.

Clostridium Welchii, although sometimes found in vaginal swabs is a rare cause of infection. Considerable tissue damage or a retained dead and macerated foetus are generally associated with infection by this organism. Jaundice due to hæmolysis may be present, and hæmoglobinuria may occur. Such infections may be fatal within a few days.

Though septic infection of any of the wounds left by labour will produce symptoms, infection of the placental site, as might be expected, produces the most severe illness.

Three things are proved about puerperal sepsis ; it is relatively commoner after the first than after subsequent confinements ; secondly, it bears a definite relation to injury of the soft tissues of the birth-canal, to the extent that it is more likely to develop when such damage is present, and the degree of infection is proportionate to the extent of the trauma ; and thirdly, it bears a definite relation to instrumental interference, in that damage to the tissues is much commoner in first than in subsequent deliveries, and much commoner after instrumental delivery than after natural delivery. It is well known that trauma partially devitalizes the tissues and lessens their resistance, thus making easier invasion by organisms. The source from which the organisms are derived may be either endogenous or exogenous.

Endogenous Infection

Infection caused by organisms already in the patient's body prior to the onset of labour.

Genital tract.—Experimental work has shown that small particles, when placed in the upper part of the vagina, find their way up into the uterus within a few hours. It is therefore certain that organisms, whether already present in the genital tract, or implanted there from an outside source, would make their way upwards when the uterus is in free continuity with the vagina. As hæmolytic streptococci are found in the vagina in about 3 per cent. of pregnant women, it was supposed

that the mode of genital tract infection was clear, and that genital tract infection after labour would be expected in these women. Work done on the subject showed that infection occurred in only a very small percentage of these women because the group A hæmolytic streptococcus is rarely present. Thus the hæmolytic streptococci resident in the vagina of pregnant women are unimportant as a cause of puerperal sepsis.

On the other hand, infection with the anærobic streptococcus is almost certainly endogenous. It has been shown that this organism is present in the vagina of 30 to 40 per cent. of women during the last months of pregnancy, and that it is uncommon elsewhere in the body. Infection is particularly liable to follow manual removal of the placenta or other intra-uterine manipulations.

Intestinal tract.—The fæces very rarely harbour the group A hæmolytic streptococcus; they may do so if the patient has had a recent attack of acute tonsillitis, but cannot be considered an important cause of severe or widespread infection.

Blood-stream.—Infection with the hæmolytic streptococcus may very rarely be carried to the genital tract by the blood-stream from septic foci, such as whitlows.

Exogenous Infection

Infection caused by organisms introduced from some outside source. That this is the most important cause of infection was proved without doubt in epidemics of puerperal sepsis due to the hæmolytic streptococcus which, in the past, were common in lying-in hospitals and still occasionally occur. The infection is carried from one patient to another by the hands or breath of the practitioner or nurse, and by dressings and instruments.

The throat and nasal swabs from normal individuals show that 5 per cent. carry hæmolytic streptococci and over 50 per cent. carry staphylococci. That the respiratory tracts of the attendants, contacts and the patient herself are the cause of the majority of cases of severe puerperal sepsis has been shown in investigations of a series of cases. A hæmolytic streptococcus, identical with the infecting strain, has been isolated in over 70 per cent. of cases in the throat or nose of the patient, attendant or contact. The infection is usually conveyed by the spray of saliva, either during talking, coughing or sneezing, by which instruments, dressings, the attendants hands or the patient's vulva may be contaminated.

The infecting organisms may also come from a septic focus on the skin of the contact. The dust in wards where patients with infections have

been nursed is known to harbour the organisms for long periods of time and may thus be a cause of airborne infection.

With the virtual elimination of the hæmolytic streptococcus as the cause of serious infection owing to a probable diminution in its virulence, combined with its sensitivity to penicillin and the sulphonamides, the main danger now is from the staphylococcus owing to the increasing incidence of resistant strains.

With the introduction of the antibiotics it was anticipated that serious infection would become a thing of the past. It would only be necessary to administer an antibiotic to cure every type of infection; unfortunately this has not proved to be true owing to the ability of organisms to produce strains resistant to the antibiotics.

It has been established beyond doubt that the widespread use of antibiotics leads to the emergence of resistant strains. Laboratory tests show that organisms originally sensitive have now become resistant. An antibiotic kills bacteria by interfering with their metabolism, thus stopping a specific process.

Resistance depends on the acquisition by the bacteria of an alternate chemical process by which its metabolism may be maintained or by the production of an enzyme to destroy the antibiotic, for example, penicillinase produced by naturally resistant staphylococci.

Resistant strains of bacteria arise spontaneously by mutation, but are often unstable and tend to revert back to a moderate degree of sensitivity in the absence of antibiotics. Very high degrees of resistance can be artificially produced by making successive cultures in gradually increasing concentrations of the antibiotics.

As already stated a very high proportion of normal, healthy persons are nasal carriers of staphylococci so that a considerable number of strains are present amongst the medical and nursing staff and patients in any hospital. Before the widespread use of penicillin only a very small proportion of these strains was naturally penicillin-resistant, so that the great majority of infections were caused by sensitive strains. The introduction of penicillin treatment resulted in the sensitive strains being practically eliminated whilst the resistant strains were encouraged to flourish. The result is that the incidence of carriers of resistant strains of staphylococci among hospital nursing staffs has now risen to between 70 to 80 per cent., these resistant strains are also harboured in dust and bedding.

This frequency of infection with penicillin-resistant strains of staphylococci in hospital practice is not only of importance in puerperal sepsis, but also in breast infections, for which penicillin treatment has now become almost useless, and is also a source of danger to the new born baby.

Pathology

The organisms, having gained a footing in the wound or wounds, set up a suppurative or necrotic inflammation. The subsequent course of events will depend on these factors :

1. The virulence and powers of invasion of the organisms.
2. The resistance of the patient.
3. The amount of tissue trauma.

If the infection remains localized, the woman suffers from a mild or profound toxæmia as the result of absorption from the infected area, but the outlook is good compared with that which obtains when it spreads beyond the original focus. Extension of the infection may be by direct spread through the tissues; direct spread up the birth-canal, or spread *via* the blood-vessels. Such spread may be local or general.

Local spread extends from the site of infection by direct spread and along the lymphatics and veins to neighbouring tissues, for example to the uterine muscle and Fallopian tubes and thence to the peritoneum, giving rise to peritonitis, or to the pelvic cellular tissue with resultant pelvic cellulitis.

Generalized spread implies the entrance of the organisms into the blood-stream, producing septicæmia. It is most serious, for parts of the body remote from the original focus, such as the lungs, pleuræ and pericardium, may be infected. Occasionally, abscess formation occurs in such places remote from the original focus, and to this clinical condition the name pyæmia is applied. When the infection remains localized in the wounds or spreads locally in the pelvis, the symptoms produced are in the main due to toxic absorption from the area of infection. When the infection becomes generalized by the blood-stream, with or without distant abscess formation, the symptoms may be produced from any infected organ however distant it may be. The degree of toxæmia will be least when the infection is limited to the wounds, more when it has spread to neighbouring structures, and most severe in septicæmia. It is important to remember that in the most severe cases the patient often looks and feels well.

Signs and Symptoms

The cardinal and earliest symptom of puerperal sepsis is fever. Labour does not, as a rule, produce any rise in a woman's temperature, and the puerperium should be apyrexial. The fever of puerperal sepsis may appear within 12 hours of delivery, or be delayed to the 2nd week of the puerperium, but it most commonly appears between the 3rd and 7th days.

The rise may be abruptly high, in which event it is often accompanied by a rigor, or it may be step-like and spread over several days before a maximum is reached. Coincident with the fever, the pulse-rate is quickened, and the woman may feel ill, although even in a grave case

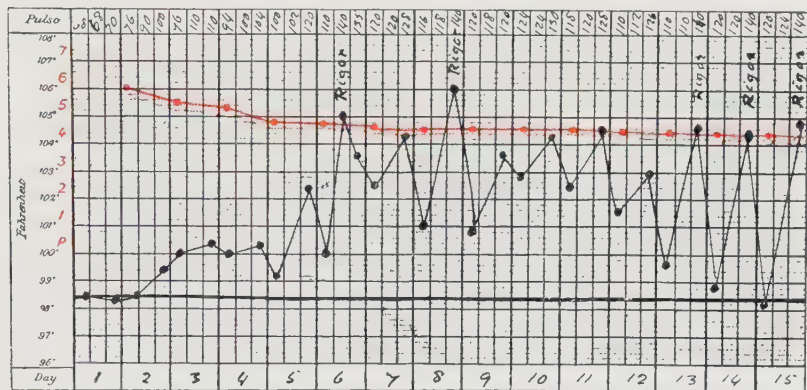


FIG. 239.—A CASE OF PUERPERAL SEPSIS OF THE SEPTICÆMIC TYPE, BUT IN WHICH THE PYRÆXIA ON THE THIRD, FOURTH, AND FIFTH DAYS SUGGESTED A SIMPLE TOXÆMIA (SAPRÆMIA).

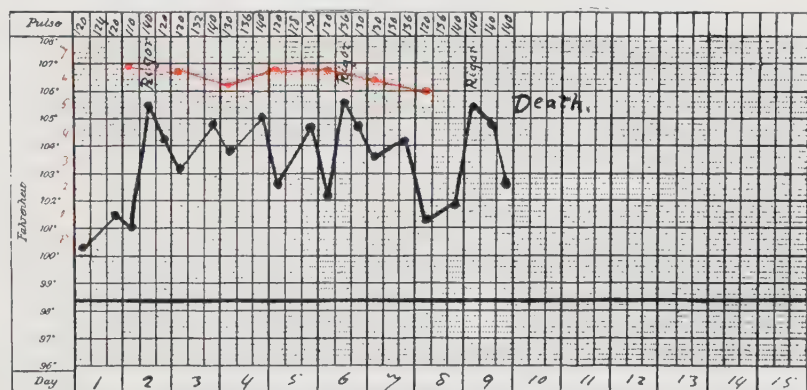


FIG. 240.—A CASE OF FULMINANT PUERPERAL INFECTION FATAL ON THE NINTH DAY.

Note the high level of the pyrexia and that fever was already present at the termination of labour.

she may often say how well she is. There is no pain at first, and often none at any time, yet tenderness over the lower abdomen is common. If, as occasionally happens, peritonitis or pelvic cellulitis develops, pain is usually localized to the pelvis or lower abdomen. The mental

condition is usually extremely clear and alert, even up to a few hours before death. The rigor which ushered in the fever may not be repeated, or may recur again and again, usually in the evening coincidentally with a rapid rise in the temperature. Some patients never have a rigor, and in others rigors appear only after the fever has lasted some days. The character of the pyrexia varies. It may maintain a constant high level, or it may be irregular.

In rare cases, especially when associated with terminal general peritonitis, fever may be absent throughout. The pulse-rate as a rule varies with the height of the temperature, but in the worst cases a high rate is maintained whether the temperature is high or low.

Pelvic cellulitis and salpingitis are both late stages of genital tract infection, and do not usually appear until the 2nd week of the puerperium. Pelvic cellulitis is due to spread of infection along the lymphatics to the pelvic cellular tissue in the broad ligament and lateral pelvic walls, and usually follows a deep cervical tear. It is associated with pain low down in the abdomen and in the inguinal regions. Diarrhoea and dysuria may occur.

Salpingitis, from spread of infection into the Fallopian tubes, gives rise to very similar symptoms. The pain is generally more severe than that associated with pelvic cellulitis, and there is a greater frequency of lower abdominal rigidity and distension. Both conditions may be associated with localized peritonitis.

The diagnosis of general peritonitis may be very difficult, especially as the characteristic signs of this infection may not be present. On the other hand, its presence should be strongly suspected if abdominal distension, generalized tenderness, and diarrhoea are associated with fever in the puerperium.

Diagnosis

Pyrexia following labour and persisting for more than 24 hours must always be assumed to be due to infection of the genital tract, until such an infection has been excluded by bacteriological examination of the lochia. The routine examination consists of a careful clinical examination including throat, chest, breasts, and abdomen, followed by taking a vaginal swab and a catheter specimen of urine for examination and culture. In taking a vaginal swab it is only necessary, after preliminary swabbing of the vulva, to separate the labia and pass the swab up into the vagina; there is no need to pass a speculum or visualize the cervix. The pathologist should be asked not only to report on the organisms cultured, but also to do sensitivity tests against the sulphonamides and antibiotics for any pathogenic organisms cultured; if this is done as a routine, much valuable time will often be saved in

beginning the most effective form of therapy. There is no indication for a routine vaginal examination, unless pelvic cellulitis or salpingitis is suspected. In most cases of pelvic cellulitis a vaginal examination will show induration of the parametrium spreading out to the lateral pelvic wall; it is usually unilateral and pushes the uterus to the other side of the pelvis. With extensive cellulitis the whole pelvis feels solid, and the area of induration may be palpable in the lower abdomen.

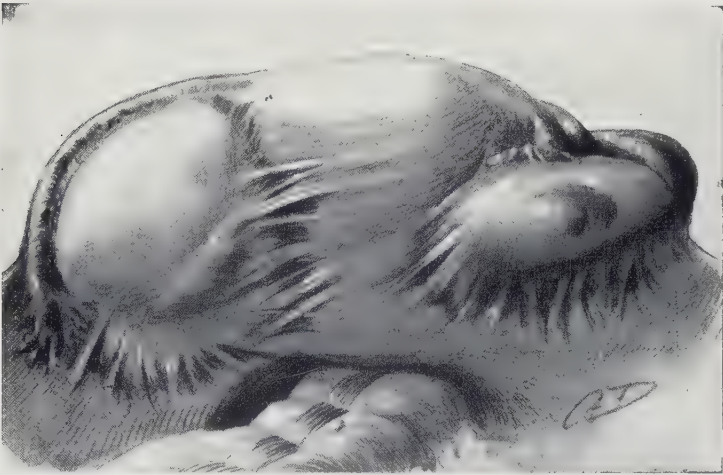


FIG. 241.—THE UTERUS AND APPENDAGES LOOKED AT FROM BEHIND.

A pyosalpinx on the right side and an ovarian abscess on the left side due to puerperal infection. The manner in which the swelling on the left side has burrowed under the left broad ligament should be noted. This is very characteristic of an ovarian abscess and causes it to simulate pelvic cellulitis.

In salpingitis a tumour, composed of the enlarged tube and ovary, with adherent omentum and bowel, can be felt behind and lateral to the uterus, on one or both sides.

Clinically, infections of the genital tract may be divided into two types :

(1) When there is obvious evidence of infection as shown by a bulky tender uterus which is not involuting normally, and a purulent offensive vaginal discharge or excess of lochia. There may also be obvious signs of infection in vaginal or perineal lacerations. This type of infection is often associated with retention of a portion of the placenta or membranes. The rise in temperature occurs about the 3rd to the 5th day, and the organisms most commonly responsible for this localized type of infection are the anærobic streptococcus, staphylococcus and escherichia coli.

(2) There may be no abnormal physical signs at all. Some of the worst cases associated with septicaemia are of this type, and show how essential it is to have a vaginal swab examined in every case. The rise in temperature generally occurs between the 1st and 3rd days. The finding of streptococci, although not positive proof that the symptoms

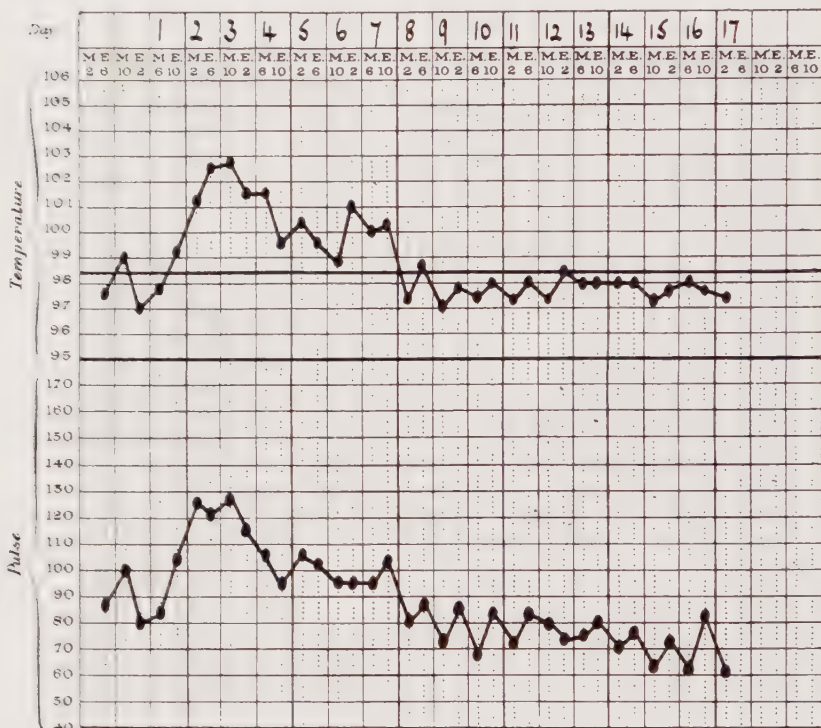


FIG. 242.

Chart of a patient who had a local uterine infection following a spontaneous delivery. The vaginal swab showed a mixed growth of bacillus coli and non-haemolytic streptococci, which responded to penicillin.

are due to sepsis, is extremely suggestive of it. The presence of staphylococci, bacillus coli and diphtheroid organisms is less positive, since these organisms are more commonly found in the vagina. In all severe cases a blood-culture should be done at the height of the rigor; the finding of organisms proves septicaemia, but their absence on one examination does not exclude it.

Prognosis

Acute anaerobic streptococcal endometritis may occur in patients whose tissues have suffered undue trauma during delivery, because

damaged tissue and blood-clot form a good culture medium for such organisms. The resulting illness is often prolonged, although the temperature and pulse-rate may never reach a great height.

In patients severely ill who present few or no physical signs, the prognosis is serious, and even more serious in those from whose blood the hæmolytic streptococcus is isolated. A negative finding on blood examination is hopeful and so, on the whole, is the finding of some definite gross lesion, for instance, cellulitis, capable of causing the symptoms exhibited.

If the blood-culture is positive, the number of streptococci per cubic centimetre of blood will form a guide in making a prognosis.

Generalized peritonitis is always serious, and if septicæmia is also present the mortality is even higher. The use of sulphonamides and the antibiotics has undoubtedly lowered the frequency with which general peritonitis occurs.

The height of the temperature is of less importance than the rapidity of the pulse-rate. When the latter remains at 120, or over, the case is a grave one. Rigors indicate the launching into the circulation of potent doses of toxin, and are, therefore, of grave import, especially if frequently repeated. A high leucocyte count suggests some local suppuration and, in so far as it points to a local lesion and a healthy reaction to it, is favourable. In the worst cases, diarrhoea and incontinence of urine may be present, and when associated with extreme mental alertness the prognosis is very poor.

Treatment

Preventive treatment.—If labour is regarded in the light of a surgical operation, a death-rate from sepsis of about 0·1 per thousand is low. If we regard it as a natural process, it is high. Whether high or low before the introduction of penicillin and the sulphonamides the death-rate from puerperal sepsis had remained practically constant for many years, notwithstanding an immense amount of effort, whilst the death-rate from sepsis following surgical operations had steadily diminished.

The origin of the infecting organisms and the agency by which they are transported to the uterus in any individual case are now fairly well understood and, therefore, it is the duty of the medical attendant to take every possible precaution to prevent infection from an outside source, during both pregnancy and labour. During pregnancy foci of infection should be looked for, and if found, treated; abstention from coitus during the last two months cannot be too strongly recommended. Vaginal examinations are necessary at some time during pregnancy, but they should be kept down to the minimum. In addition, the same strict

antiseptic technique should be carried out in making a vaginal examination in pregnancy as in labour. During labour vaginal examinations should be reduced to a minimum. Further, since it is known that sepsis much more commonly follows instrumental and assisted delivery than natural labour, interference should be restricted to those cases in which it is really necessary.

The risks of exogenous infection can be diminished in the following ways. By adequate sterilization of all instruments, appliances and dressings to be used, and thereafter seeing that they are not infected by contact or spray.

The obstetrician should work in sterile gloves and gown, all in attendance throughout labour and delivery must wear a mask which covers both nose and mouth. Masks are best made of two layers of cotton with a layer of paper intervening.

Septic patients must be isolated, ideally in a different building so that there is no mixing of the nursing staff between the clean and septic wards. If the patient has been delivered at home she should be removed to a special isolation hospital where there are adequate facilities for investigation and treatment.

A constant watch must be kept on the medical and nursing staff to exclude from the department any obvious sources of infection such as sore throat, paronychia, boils and whitlows. In the event of the occurrence of more than a sporadic case of infection it is essential that swabs be taken from all those working in the department so that the source of the infection can be traced and removed.

Dust is an important source of cross infection. It can be kept down to a minimum by using vacuum cleaners instead of brushes, oiling floors and frequent washing down of walls. Blankets collect dust and the woollen variety are difficult to sterilize, they should be replaced by the terylene type. Bed-pans must be sterilized after use and soiled vulval pads should not be allowed to collect but should be burned in an incinerator with the minimum of delay.

The prevention of endogenous infection is a far more difficult problem. It is impossible completely to sterilize either the vagina or vulva. In normal circumstances, the vagina does not contain organisms of high virulence, but the vulva and the peri-anal region are heavily infected with intestinal organisms such as *escherichia coli* and *streptococcus faecalis*. These organisms are all potentially pathogenic. It is impossible to pass anything, whether sterilized or not, into the vagina, without conveying into it organisms from the introitus. In order to minimize this risk the vulva and peri-anal region must be swabbed with an efficient antiseptic, such as chlorhexidine, prior to making a vaginal examination. When manipulation or instrumental interference with

labour is called for, the patient should be placed in the lithotomy position as in an operating theatre, the vulva, and especially the region round the anus, covered with antiseptic sheeting, and the vaginal orifice and such part of its approaches as remain uncovered swabbed with the antiseptic.

The most dangerous of all procedures is to introduce anything into the uterus after the child is delivered. Manual removal of the placenta should, therefore, be avoided unless there is an absolute indication.

The general use of antibiotics and chemotherapy for prophylaxis cannot be too strongly condemned. It is not only ineffective, but positively dangerous, as it encourages the production of resistant strains of organisms. Only in the most exceptional case, such as gonococcal vaginitis, would prophylactic treatment be justifiable.

General treatment.—The patient must be nursed in isolation. If the case occurs in domiciliary practice she should be transferred to an institution where all facilities for diagnosis, nursing and treatment are available.

The fluid intake must be adequate and the patient made comfortable by good nursing, analgesics to relieve pain, and sedatives to ensure rest. Hæmoglobin estimations should be done every 2 or 3 days since anæmia is commonly associated with severe sepsis and one or two transfusions of fresh blood may be required.

Local treatment.—If an infected perineal wound is present, the stitches should be removed and the laceration irrigated with eusol, dried and dusted with sulphathiazole and penicillin powder.

In cases of pelvic cellulitis or salpingitis heat should be applied to the lower abdomen by kaolin poultices, or a radiant heat lamp. Hot vaginal douches or pelvic diathermy may be used in cases of chronic cellulitis, because the local application of heat may assist resolution or result in an abscess pointing externally, when it can be incised and drained.

Antibiotics.—The importance of sensitivity tests done as a routine on the organisms cultured from the first vaginal swab has already been mentioned, since these tests will enable the correct antibiotic to be selected with certainty, but at least 48 hours and probably longer must elapse before this result can be obtained.

In view of the decreased incidence and severity of genital tract infection there is no urgency in starting antibiotic therapy. It is, therefore, generally wise to wait until the infecting organism has been identified by bacteriological findings. Treatment can then be started with the correct antibiotic.

Operative. Operative treatment has little place in puerperal sepsis, and is generally confined to exploration of the uterine cavity for the

removal of retained pieces of placenta. It is sometimes necessary to drain a pelvic abscess by an incision either in the posterior vaginal fornix or rectum. Pelvic cellulitis may sometimes result in an abscess pointing under the skin of the abdominal wall, generally just above the outer end of the inguinal ligament, or below the kidney in Petit's triangle, which will require incision and drainage.

2. Urinary Tract

Infection of the urinary tract is the commonest cause of puerperal pyrexia. The infection is almost always introduced by catheterization, which is frequently necessary during labour and sometimes in the puerperium. The infection is generally due to *escherichia coli*.

During the second stage of labour the patient is often unable to pass urine spontaneously owing to pressure on the urethra by the presenting part, and the stretching of the urethra due to elevation of the bladder. Besides giving rise to considerable discomfort, the distended bladder inhibits the expulsion of the child, and it is therefore necessary to empty the bladder by catheterization. Catheterization is essential before forceps delivery, because a full bladder, predisposing to uterine inertia, will almost certainly result in post-partum hæmorrhage.

After delivery, particularly when there has been a perineal laceration or episiotomy requiring sutures, the painful perineum inhibits the act of micturition, and this leads to retention of urine which will require relief by catheterization on at least one occasion. Apart from catheterization, the bruising and stretching of the tissues during delivery may be sufficient to give rise to a recurrence of a pre-existing chronic and symptomless infection.

Diagnosis

This is made on examination of a catheter specimen of urine. Part of the specimen should be sent to the laboratory for examination of the deposit, culture and sensitivity tests, but immediate examination of a drop under the microscope will often settle the diagnosis; a large number of pus cells in the field makes the diagnosis of a urinary infection certain. The symptoms of such infection, dysuria and frequency, are often equivocal, since they are common after delivery even in the absence of infection.

Treatment

In order to prevent urinary infection, catheterization should be restricted to those cases in which it is indicated, and then performed with strict aseptic technique. When there is a history of a recent

urinary infection, a small prophylactic dose of one of the sulphonamides, e.g. sulphadiazine, 0.5 gm. t.d.s. may be given during labour and continued for the first 3 or 4 days of the puerperium.

In the established case the fluid intake must be at least six pints in the 24 hours. The urine should be made alkaline by giving a mixture of potassium citrate and sodium bicarbonate, a.a. gr. 20 4-hourly, or more frequently if necessary, as judged by testing every specimen of urine with litmus paper, and a course of one of the sulphonamide drugs should be given, e.g. 1.0 gm. sulphadiazine 4-hourly, up to a total of 25 gm.

Occasionally the sensitivity tests may show that the organism is resistant to the sulphonamide group of drugs, and it will then be necessary to use the appropriate antibiotic.

3. Breast Conditions

After urinary and genital tract infections, the breasts are the commonest cause of pyrexia in the puerperium. Two conditions arise, engorgement and infection.

Engorged Breasts

About the end of the 3rd day the breasts become engorged with blood and begin to secrete milk, and if the child does not empty them sufficiently, the breasts rapidly become over-distended. They are enlarged and covered with dilated veins; the skin over them may be slightly congested. They are very tender and painful, and when touched are found to be hard and knotty. Nodules of engorged breast tissue may be palpable in the axilla. Such a condition is very painful to the patient and may prevent her sleeping.

Treatment.—Prophylactic treatment of the breasts during pregnancy will help to promote successful breast feeding by preventing engorged breasts with the risk of subsequent infection.

The nipple should be protractile, that is to say it should stand out well when grasped between the finger and thumb, so that when the baby sucks he can get the whole nipple into his mouth with his jaws around the areola. If the nipple is retractile the baby will be unable to get it properly into his mouth and tends to bite it causing abrasions which will be a cause of pain to the mother and may lead to infection.

A retractile nipple can frequently be converted into the normal protractile type if suitable nipple shields are worn under a well fitting brassiere during the last three months of the pregnancy.

In order to prepare for lactation and ensure an easy flow of milk along the ducts of the breast and from the nipple expression of colostrum

from the breasts is practiced for ten minutes a day for the last two months of the pregnancy. There is no doubt that this practice greatly diminishes severe breast engorgement during the puerperium.

In the early stages of engorgement the child may be able to take enough milk to relieve the congestion but once the condition is fully established, there is sufficient congestion and pressure on the ducts to prevent the flow of milk and the child from emptying the breasts so

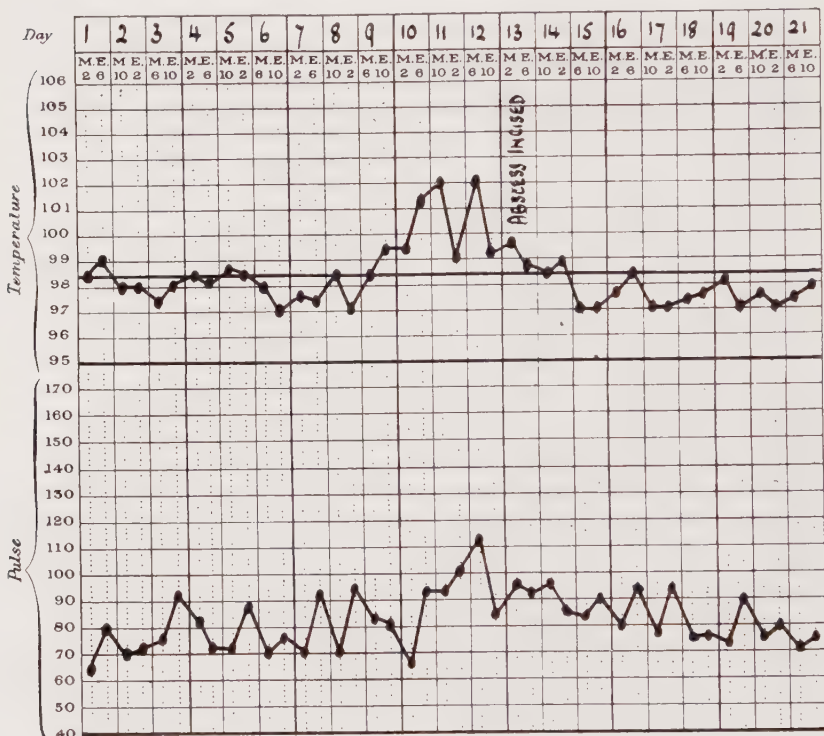


FIG. 243.

This patient developed an infection of the left breast on the ninth day of the puerperium. She was treated for three days with a million units of penicillin a day, and the abscess was incised and drained on the thirteenth day.

that they become extremely painful and tender. This engorgement can be relieved by giving oestrogens, *e.g.* ethinyl oestradiol 0.5 mg. if necessary repeating the dose in six hours. A little milk should be manually expressed before putting the baby to the breast as this will help to promote an easy flow of milk. Hot fomentations are also helpful in relieving the pain and congestion of the acute stage and a sedative should be given at night.

Infective Mastitis

Infective mastitis has been occurring in epidemics in hospital practice during the last few years and has now almost completely replaced genital tract infection as the cause of prolonged morbidity in the puerperium.

The infecting organism is almost always the staphylococcus aureus, frequently of the resistant phage type 80. All that has been said regarding the prevalence and problems of infection with this organism in relation to puerperal sepsis applies equally to breast infections. In addition the baby is a frequent source of infection to its mother's breasts. It has long been known that breast infections were liable to occur in association with skin infections of the baby and that such infections spread rapidly in a nursery unless isolation and the most careful aseptic techniques are practiced.

Bacteriological investigations carried out in recent epidemics of breast infections with the staphylococcus aureus, phage type 80, have shown that if one baby in the nursery has the organism in its nose or mouth, almost all the other babies will be similarly affected within two or three days. These affected babies, seldom ill and generally thriving, are a dangerous source of infection to their mothers.

There are two main types of mastitis depending on the site of infection. Cellulitis when the infection enters a crack in the nipple and spreads to involve interlobular connective tissue, and adenitis, when the infection is primary in the lactiferous system, there being no break in the surface epithelium of the nipple. The second type is seen in epidemics being confined to hospital practice. The condition may arise at any time in the puerperium, the patient complains of pain in the breast and her temperature may rise as high as 105° F. In both types the clinical picture is the same, the infection being limited at first to one lobe. A wedge-shaped area of cutaneous hyperæmia can be seen, its apex at the nipple, the affected area of the breast is tense and tender. Unless early treatment is successful the condition will give rise to a breast abscess.

Treatment.—Prophylaxis consists in the most scrupulous attention to asepsis. The umbilical cord is a common site for infection and must be inspected daily. Any baby or mother with an infection must be removed from the nursery, or ward, and isolated. Ideally the mother and baby should be kept together; the mother should, as far as possible, be encouraged to attend to her baby's needs herself thus reducing its handling by other persons to the minimum.

Routine bacteriological checks should be made in the labour wards, lying-in-wards, and nurseries as well as for the sterility of instruments,

dressings and appliances. It is only by constant vigilance that serious epidemics can be prevented.

In the event of infection, no time should be lost in calling for the assistance of the bacteriologist ; in many hospitals antibiotics are only given with his advice.

As soon as mastitis occurs breast feeding should be suspended and the breast should be firmly supported over a large pad of cotton wool. A sample of milk should be taken and sent to the laboratory for culture and sensitivity tests as it is almost always possible to grow the infecting organism from the milk.

If antibiotic treatment is going to prevent an abscess it must be started immediately. Penicillin 500,000 units by intramuscular injection given twice a day for 48 hours may result in resolution without abscess formation in domiciliary practice when the organism is likely to be sensitive. In hospital the organism will probably be penicillin resistant but since the sensitivity of the prevalent strain will be known, treatment with the appropriate antibiotic should be started. When the report on the culture from the milk is available it will provide an accurate indication as to the choice of antibiotics.

Abscess of the Breast

A mammary abscess follows an acute mastitis which has failed to resolve. A segment of the breast becomes painful, tender, œdematous and usually reddened. The temperature is raised, the pulse-rate is quickened and the axillary glands become tender and enlarged. The abscess may form near the surface or in the substance of the breast. The latter is naturally more serious and, if neglected, may burrow deeply in all directions and lead to almost total disorganization of the breast.

Treatment.—Breast feeding and proper treatment of the breast abscess are incompatible. The child must be taken from the breast, alternative feeding arranged and lactation discouraged by œstrogen therapy. As soon as an abscess forms it should be drained. To wait for fluctuation is to wait too long, the presence of brawny œdema of the skin makes the diagnosis almost certain. The incision should radiate from the nipple in order to avoid cutting the ducts. Since these abscesses have loculi running in different directions, and not infrequently consist of a superficial and deep portion connected by a narrow track, the incisions should be free and deep and the gloved finger should be inserted into the abscess and all septa and loculi broken down. A drainage tube should be inserted and it is sometimes necessary to make a counter-incision to obtain dependant drainage.

The Prevention of lactation.—In the last few years, oestrogens have proved to be the most efficient therapeutic agent for preventing the secretion of milk, and for inhibiting the supply, after lactation has been established.

When the mother is not going to feed her child for any reason the secretion of milk can be prevented by giving ethinyl oestradiol 1.0 to 1.5 mg. daily, for the first 5 days after delivery. This simple therapeutic measure disposes of the necessity for local treatment, such as firm bandaging and belladonna plasters. Limitation of the patient's fluid intake may be required, and the bowels made to act two or three times a day.

When the mother has nursed the child for some months and is going to wean it, similar treatment will be efficient in stopping secretion. The process of weaning, which formerly took two or three weeks, can, so far as the mother's comfort is concerned, be completed in 3 or 4 days.

4. Thrombo-phlebitis

This is a late cause of puerperal pyrexia, as it generally occurs about the 10th day of the puerperium, but may be as early as the first or as late as the 20th day.

Ætiology.—Thrombo-phlebitis is frequently associated with anæmia, pelvic infection, and difficult delivery with tissue damage. Varicose veins predispose to superficial thrombo-phlebitis. Many cases arise without any obvious predisposing cause, but it is most probable that they are generally associated with a mild pelvic infection, for on looking back on cases which develop thrombosis, it is common to find that the patient had a low grade pyrexia in the region of 99° F. for several days.

Deep femoral thrombosis.—Pain generally commences in the calf of the leg, also behind the knee and in the ankle, and is accompanied by œdema of the leg and ankle. The thrombosis may spread upwards to involve the superficial or deep veins of the thigh, when the pain and swelling will extend up to this region also. If the main lymphatics of the limb are also involved in a deep cellulitis, the whole limb may become solid with œdema; the skin is white and shiny, and the limb is very much enlarged giving rise to great discomfort. This is the condition known as white leg or phlegmasia alba dolens, now fortunately a rare condition.

Diagnosis.—It is of the utmost importance that thrombosis should be diagnosed when it is still limited to the deep veins of the calf. The early signs are tenderness on deep palpation in the back of the calf, and that passive dorsiflexion of the foot while the knee is kept extended gives rise to pain in the calf, associated with œdema of the leg. If the

thrombosis is spreading upwards, involvement of the popliteal vein can be demonstrated by palpating the tender thickened vessel.

Prognosis. This has been completely altered by the introduction of the anticoagulant drugs. Prior to their introduction it was necessary to keep the patient in bed until the temperature and œdema had subsided, a period of 6 to 10 weeks, but the anticoagulants have cut this time down to 10 to 14 days.

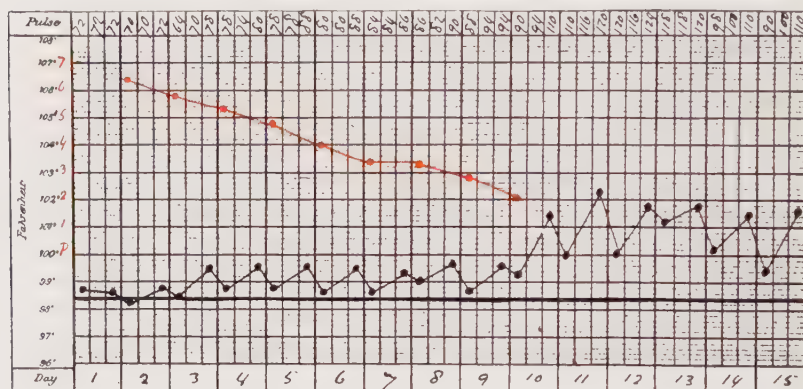


FIG. 244.—A CASE OF FEMORAL THROMBO-PHLEBITIS

Note that the pyrexia which began on the 10th day was preceded for several days by a certain slight irregularity of temperature. This is the normal course of events in such cases. The involution curve is practically normal.

The prognosis is generally excellent, but even with anticoagulants death occasionally occurs from pulmonary embolism or thrombosis of the inferior vena cava.

Treatment.—The best way to prevent deep femoral thrombosis is by careful and gentle delivery to avoid tissue damage as far as possible : to treat anæmia by the administration of iron during pregnancy ; by blood-transfusion when the patient has had post-partum hæmorrhage ; to prevent puerperal sepsis ; and to advise routine post-natal exercises, beginning on the day after delivery.

Anticoagulants.—Heparin was the first anticoagulant to be introduced. Its main disadvantage is that it must be given by intravenous injection but this can be largely overcome by inserting a Gordt needle into a vein, where it can remain for several days and giving the heparin through this. The dosage of heparin is 12,000 units initially, followed by 10,000 units every 4 hours continuing for 4 to 5 days. At one time it was considered necessary to control the dosage by estimations of the blood-clotting time, but these estimations are so inaccurate that the control has been abandoned.

Heparin has the advantage that it acts quickly and is also rapidly excreted from the body so that if a hæmorrhage occurs it is generally only necessary to stop administration of the drug. The antidote is protamine sulphate, 1 to 5 c.c. of a 1 per cent. solution being injected intravenously.

The other anticoagulants in common use are traumexan and dindevan. Both have the advantage that they are given orally, but their action is delayed for about 24 hours, and the initial period is generally

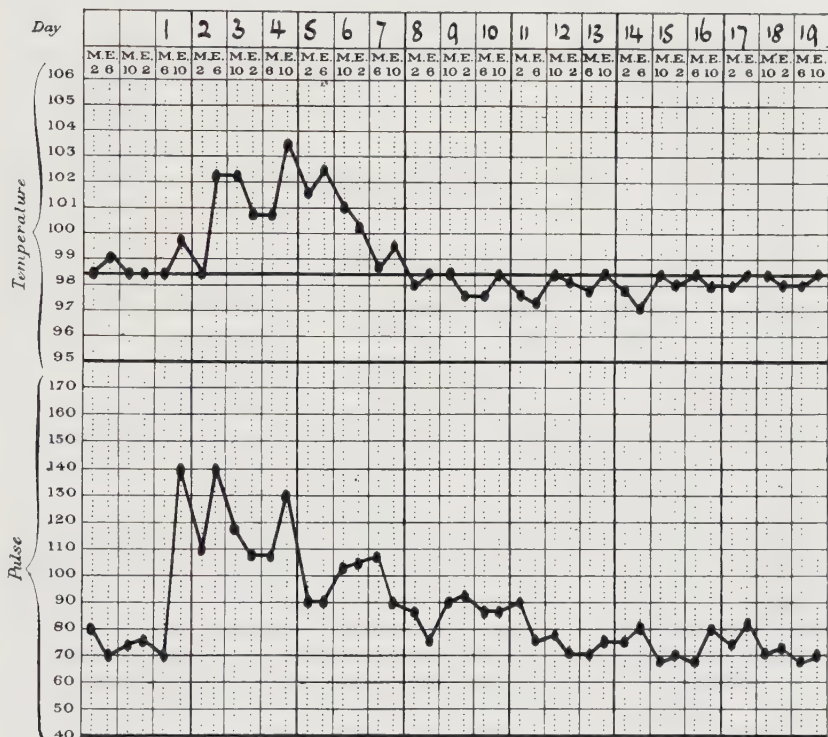


FIG. 245.

This patient had a forceps delivery for deep transverse arrest. She developed an inhalation pneumonia on the day after delivery, which was treated with penicillin, a million units a day for five days.

covered by several doses of heparin. Since their effect is variable the dosage has to be regulated against the patient's prothrombin time so that they can only be used when laboratory facilities are available.

On the first day of treatment 10,000 units of heparin are given intravenously every six hours, the first dose being combined with either traumexan, 1,200 mg., or dindevan, 300 mg., given by mouth. On the following days the treatment is continued with traumexan or dindevan

given in divided doses two or three times a day, the amount being regulated by the prothrombin time which should be kept at two to two and a half times the normal.

It is essential to give an adequate course of anticoagulant therapy extending over at least 4 days; this treatment frequently produces hæmorrhages from the placental site, gums and renal tract. These hæmorrhages are usually slight and of no consequence, but occasionally, particularly early in the puerperium, severe hæmorrhage may occur from the placental site; in this case the anticoagulant must be stopped and the patient given vitamin K1 150 mg. intravenously, and a blood-transfusion.

The pain and pyrexia generally subside quickly on anti-coagulant therapy and the patient is usually able to get up at the end of 7 to 10 days, but there is often some residual œdema of the leg which may persist for some months, or even remain permanently. An elastic stocking, put on in bed before getting up in the morning should be worn for 3 to 6 months.

Superficial Thrombo-phlebitis.—This occurs with some frequency in the superficial veins of the leg and usually is not of serious import. The skin over such a thrombosed superficial vein will be red, and the solid clot in the vein can be palpated with ease. Although tender at first, the pain will gradually disappear. Treatment is best carried out by strapping the whole area with elastoplast, and getting the patient up and walking as soon as possible.

Prophylactic treatment is necessary for patients with varicose veins; the legs should be protected against trauma during labour, which may result when the leg is held for some time, often with force, owing to the lack of co-operation by the patient. The best method of protection is to cover the leg with gamgee tissue loosely bandaged over the whole area of the varicose veins.

Since the treatment with anticoagulants is not devoid of dangers it is not indicated with superficial thrombosis as it is unnecessary.

5. Respiratory Tract Infection

Infections of the respiratory tract are liable to arise at any time, and the puerperium is no exception. When an anæsthetic has been given during labour, post-anæsthetic chest complications, such as basal collapse, may occur.

6. Other Causes of Pyrexia

Tonsillitis, influenza, or any of the acute specific fevers, may occur in the puerperium, as well as surgical conditions such as appendicitis.

CHAPTER XLIV

MAMMARY DISTURBANCES

Cracked Nipples. —The nipple may become sore and painful from two conditions. One consists of a loss of the epithelium covering a considerable area of the nipple, with the resulting formation of a raw area which is very tender. The other is a small deep fissure situated either at the tip or the base of the nipple. The two conditions frequently exist simultaneously and are referred to as cracked nipples.

The cracks may be caused by lack of care before delivery in not keeping the nipple clean and free from crusts, and also in not treating flatness of the nipple. After delivery a flat nipple, or one that is not kept aseptic and dry, tends to become sore. If there is not sufficient milk in the breast a hungry child will suck too vigorously and its gums cause abrasions of the epithelium. Another cause is putting the child to the breast too frequently and leaving it there too long during the first three days after delivery when the supply of milk is not established. The nipples may also become sore if, when the child is suckled, the mother does not depress the breast away from the child's nostrils with her fingers, since, if the child cannot breathe through its nose, it has to drop the nipple repeatedly and then take it up again. Thrush is an occasional cause of soreness of the nipple.

Cracked nipples cause tenderness and pain during suckling. There is also a risk of a mammary abscess forming, as the raw area acts as a means of access for infecting organisms. An important symptom is the vomiting of altered blood by the baby, as it draws maternal blood with the milk into its stomach, and since the blood usually causes vomiting it may give rise to the idea that hæmorrhage is occurring from the wall of the infant's stomach.

Treatment.—Cracked nipples should be prevented by the treatment described on p. 161. If the nipples are hard and inclined to crack, lanoline may be applied. During the first 3 days the child should be put to the breast for only a few minutes, and in no circumstances allowed to sleep with the nipple in its mouth. At the end of each feed the nipple must be cleaned and dried as already described. Once it has become sore an antiseptic should be applied to it, one of the best applications being tinct. benzoini co. (Friar's balsam) as it forms a protective covering over the painful area.

If suckling is very painful, a sterilized nipple shield of glass or rubber may be tried. In severe cases the child should not be put to the affected

breast for 48 hours ; during that time the nipple is kept covered with Friar's balsam. Meantime the breast should be emptied by manual expression.

Galactoceles.—A galactocoele is a retention cyst of one of the larger mammary ducts. Its contents is chiefly milk. It is probable that most of these swellings owe their origin to inflammatory changes in the wall of the affected duct, whereby the lumen becomes occluded. As a result the retained milk is usually mixed with pus, and droplets of free fat are often present. A local fluctuating swelling can usually be felt and the skin over it is reddened. The general appearance suggests a large abscess but the pain is much less and there is no constitutional disturbance. A galactocoele when small and deeply situated may be mistaken for a carcinoma in the breast. The cyst should be excised.

Galactorrhœa.—This is a condition occasionally met with when a continuous flow of pale watery milk occurs from the nipple. The amount lost each day amounts to a considerable quantity. The breast does not in many cases present external signs of great activity, indeed it is often quite flaccid. Sometimes only one breast is affected. The cause is unknown.

The fluid is of little nutritive value. In many cases weaning has already been carried out. If it has not, the child should be withdrawn permanently from both breasts and artificially fed. To stop the secretion of the breasts, the mother should be given stilbœstrol 5 to 10 mg. by mouth daily for 5 days.

Carcinoma of the Nursing Breast.—Carcinoma, when it develops in the nursing breast, grows with great rapidity and is very malignant. The affected breast is larger than the other, the nipple is flattened or retracted and more or less fixed, and the skin over the tumour is in a condition of firm tumidity—the so-called pig-skin thickening. It may present a distinct blush or even obvious capillary injection, if the growth is close to the surface.

Immediate recognition is of the utmost importance. The rapidity with which the enlargement makes its appearance and the reddening of the skin over it often suggest mastitis. The fact that the swelling has appeared without pain and is scarcely tender to palpation should at once give a clue to the right diagnosis.

A small deep-seated galactocoele may resemble carcinoma, but the cyst may be made to fluctuate and the skin over it is neither adherent nor thickened.

The diagnosis must be confirmed by biopsy and the treatment will then be by irradiation.

CHAPTER XLV

BLOOD-TRANSFUSION IN OBSTETRICS

ACUTE hæmorrhage of large amount may occur in women with central placenta prævia, in cases of severe accidental hæmorrhage and in the third stage of labour. If the blood-pressure falls in consequence the oxygen supply to the vital centres is endangered and it may be of the utmost importance, if life is to be saved, immediately to restore the blood-volume by the urgent transfusion of blood or other fluid into a vein. In the report of the Ministry of Health on enquiries into 1094 maternal deaths in England and Wales in 1952, 1953 and 1954, it is stated that 214 (19·5 per cent.) were directly due to hæmorrhage, and two-thirds of these deaths were considered to be avoidable. In view of the present availability of blood and plasma substitutes and because all areas are served by mobile blood-transfusion units ("flying squads") there can be scarcely any excuse for a maternal death from hæmorrhage in Great Britain. Women who are anæmic are less able to withstand large losses of blood and blood-transfusion may occasionally be needed to raise the level of hæmoglobin before labour if response to other measures is poor or time is short because term is approaching.

The first successful blood-transfusion was carried out on a woman who had had a post-partum hæmorrhage, by Blundell of Guy's Hospital in 1829. However, it was not until Landsteiner in 1900 showed how blood samples could be placed in one of four incompatible groups, the ABO blood groups, that transfusion could be undertaken without great risk of severe, often fatal, reaction. The discovery of the Rh blood group system in 1940 by Landsteiner and Wiener further explained the occasional hæmolytic reaction following transfusion with ABO compatible blood. Since then fifty-nine other antigens (MN, S and Kell are examples) and their equivalent antibodies have been identified in human blood, but they only cause hæmolytic reactions on very rare occasions and then only in patients who are repeatedly transfused or who have been immunized by repeated pregnancies.

For the blood-pressure and the oxygen supply to the vital centres in the brain to be maintained, an adequate volume of blood must be circulating. Whole blood consists of plasma and red cells. The volume of circulating plasma can be estimated by measuring the concentration after injection into the blood stream of a dye, such as Evans Blue (T-1824), or radio-active iodine, ^{132}I ; and the volume of red cells can

be estimated by measuring the dilution after injection into the blood-stream of a known amount of red cells labelled with radio-active phosphorus, ^{32}P , or radio-active chromium, ^{51}Cr . If the venous hæmatocrit is known, measurement of either the plasma or red cell-volume will allow the other volume to be estimated and from these two volumes the total blood-volume can be deduced. More accurate deductions of the total blood-volume are obtained, if the plasma volume and red cell-volume are measured separately. Thus it is found that the average non-pregnant woman weighing 9 stones (57 Kg.) has a total blood-volume of about 4000 ml. (70 ml. per Kg.) with a venous hæmatocrit of 41 per cent. In pregnancy the blood-volume increases by about 25 per cent., reaching a maximum between 33 and 38 weeks. This is mainly due to an increase in plasma-volume and hence hæmoglobin and hæmatocrit values fall. At the end of pregnancy the total blood-volume is about 5000 ml. The pregnant woman at term can tolerate sudden losses of blood up to 1000 ml. without much fall in blood-pressure, the body adjusting itself temporarily by peripheral vasoconstriction. With greater losses of blood the blood-pressure falls and the oxygen supply to the vital centres becomes inadequate. An acute hæmorrhage of 50 per cent. of the blood-volume, 2500 ml. in the pregnant woman at term, is nearly always fatal if not treated promptly. In untreated cases which survive, the blood-volume after hæmorrhage is gradually restored over 36 hours due to increase in the plasma volume, and hence the hæmoglobin concentration and hæmatocrit value fall during this time. The rate of restoration of the plasma volume is governed by the rate at which proteins are added to the circulation. Thus it is not possible to restore plasma volume by giving intravenous saline because the saline soon escapes from the vessels into the extravascular fluid.

Although blood is the logical fluid to give to restore blood-volume after hæmorrhage it is a highly complex substance and the greatest care must be taken to ensure complete compatibility before transfusing. Extensive hæmolysis of the transfused cells occurs if they are incompatible and this may lead to further hæmorrhage or even fatal anuria, and if she survives the patient's anæmia remains. It is wise to regard the hazards of a blood-transfusion as equivalent to those of an anæsthetic. If really indicated no-one would hesitate to embark upon either. On the other hand, neither should be given for trivial reasons. Moreover, the demands for blood in modern operative and traumatic surgery are greater than the supply and willing donors are becoming increasingly difficult to find. It is often safer to restore blood-volume after hæmorrhage by the infusion of a plasma substitute; and the anæmia can be treated subsequently by giving iron without risk.

Symptoms and Signs of Acute Hæmorrhage in Obstetric Patients

The sudden loss of blood that occurs in an obstetric patient affords the attendant an opportunity to observe the clinical picture of uncomplicated acute hæmorrhage that is seldom obscured by other signs or by previous illness of the patient. The effects are similar to those produced by experimental venesection on volunteers, and depend on the amount of blood lost and the rate of bleeding. There are two main effects, the vaso-vagal attack, or faint, and the circulatory effects. In severe bleeding both effects are seen.

Vaso-vagal attack.—This appears to be a hypothalamic response. It occurs in some patients at the mere sight of blood, but it can also be induced in all experimental subjects by withdrawing a sufficient quantity of blood. The patient begins to sweat and turn pale; she feels weak and nauseated and may vomit; objects appear dim and loss of consciousness may follow. The skin feels cold, the blood-pressure falls, sometimes alarmingly, but the heart-rate slows and the pulse may fall to as low as 30 per minute. There may be vomiting or involuntary defæcation and convulsions are occasionally seen. These changes are probably brought about by the autonomic nervous system causing slowing of the heart, sweating, and vomiting and dilatation of the arterioles which leads to the fall in blood-pressure; and by the secretion of posterior pituitary hormone as shown by constriction of capillaries with blanching of the skin and inhibition of urine secretion. It is important to realize that this appearance of profound collapse may be brought on by a comparatively small loss of blood or even by emotion alone. The diagnosis is made by appreciating that there has not been much blood lost and by finding a slow pulse. Provided that the patient remains supine, preferably with the head lower than the rest of the body, recovery is rapid without further treatment, although the circulatory effects due to reduced blood-volume may begin to be apparent if the amount of blood lost is more than 1000 ml. Then the patient continues in a state of collapse.

Circulatory effects.—The loss of up to 500 ml. of blood usually produces very little effect on the circulation; the blood-pressure and pulse-rate do not alter as a rule. With losses between 500 ml. and 1000 ml. the effects are not marked unless the patient attempts to sit up. But patients who lose 1000 ml. or more show all the features of wound shock within a few minutes; they are collapsed, restless and pale and the skin is cold and clammy; sometimes they have air-hunger; the pulse is fast and thready and the blood-pressure falls. These effects are entirely due to a reduced blood-volume, which in turn produces a lowered venous pressure, a low right auricular pressure and a

low cardiac output in spite of the increase in heart-rate. The fall in blood-pressure is the best index of the reduction in cardiac output, although an accurate assessment of the blood lost is the most valuable guide as to prognosis and treatment. The fitness of the patient before her hæmorrhage has an important bearing on her ability to withstand severe bleeding. With the same amount of blood lost small, unhealthy, anæmic patients collapse more readily than do large, fit women with previously normal hæmoglobin concentrations. The rate at which the blood is lost is also important, but not nearly so as the amount. Anaesthesia may temporarily postpone the circulatory effects of large blood loss, but unless the blood-volume is restored collapse will occur as the anæsthetic wears off.

Indications for Transfusion

Following hæmorrhage.—The urgency for transfusion depends upon the amount of blood lost and the rate of bleeding; the condition of the patient as a result of hæmorrhage; her state of health before the bleeding; the likelihood of further loss of blood and the possible need for operation and an anæsthetic. Any patient who loses more than 1000 ml. (1·8 pints) of blood rapidly, should be considered as likely to need a transfusion. The time to consider transfusion is before the patient collapses, not after. This is more definitely so if she is known to have been anæmic before the hæmorrhage, if bleeding continues or is likely to recur as in the case of a retained placenta or a placenta prævia, or if an operation, such as manual removal of the placenta or Cæsarean section, is being contemplated.

The risk of hæmorrhage is reduced if the bleeding takes place in hospital where there are facilities for immediate blood replacement. For this reason it is most important to heed the warning of ante-partum losses of placenta prævia and to admit such cases into hospital without precipitating severe bleeding by examining them with a finger through the cervix. When a case of ante-partum hæmorrhage is being examined in the operating theatre under an anæsthetic in order to establish the diagnosis, blood should be ready and cross-matched; and it is good practice to have a glucose-saline drip running so that blood can be transfused as soon as it is needed.

In revealed accidental hæmorrhage the loss of blood is usually not severe enough to need replacement. But in concealed accidental hæmorrhage the bleeding, both retained in the uterus and passed *per vaginam*, is often heavy and not infrequently demands transfusion. This is especially so in the unusual complication of this condition in which there is incoagulability of the blood due to afibrinogæmia. Severe continued post-partum hæmorrhage may occur. For reasons

that are not understood, unless the blood transfused is fresh, the fibrinogen replacement is inadequate by transfusion alone and extra fibrinogen must be given.

Sometimes after a traumatic delivery with forceps or following repeated unsuccessful attempts at Crede's expression of the placenta, or in cases of acute inversion or rupture of the uterus, the patient collapses. Such a collapsed condition is often referred to as obstetric shock. Nearly always careful assessment will reveal considerable loss of blood from the uterus or from vaginal or perineal lacerations in these cases and a large quantity of blood may be retained in traumatized tissues. This explains why they frequently respond to transfusion.

When post-partum hæmorrhage occurs in the patient's home it is most unwise to transfer her to hospital with the placenta undelivered; further severe hæmorrhage may occur while waiting for the ambulance or during the journey to hospital. It is better to bring blood and those expert in giving it to the patient in her own home and to resuscitate her and deal with the obstetric emergency there.

In anæmia of pregnancy. It is impossible to be sure that a patient will not bleed during or after labour and delivery. For this reason it is essential to make sure that pregnant women do not reach term with a hæmoglobin concentration below 10 g./100 ml. (67 per cent. Haldane). Almost always a good supply of iron during pregnancy will ensure this. Occasionally the iron is not absorbed or cannot be tolerated and then it has to be given intramuscularly or intravenously. Rarely a macrocytic anæmia that fails to respond to iron is diagnosed and folic acid has to be given. On the occasions when an anæmic patient is seen for the first time in pregnancy too late for medical treatment to take effect in time for labour, a blood-transfusion may have to be given. It is hardly ever necessary to give blood in the puerperium to a patient who is anæmic as a result of post-partum hæmorrhage. One bottle of blood will raise the hæmoglobin by only 10 per cent. and the response to iron by mouth is usually rapid.

Assessment of the Patient after Acute Hæmorrhage

In deciding whether or not to transfuse a patient, it is important to take into account both the clinical condition and the amount of blood lost. It has been pointed out that a picture of profound collapse can be presented by a patient who has lost only a trivial amount of blood. This is due to a vaso-vagal attack and recovery is spontaneous and rapid if the patient is kept supine. On the other hand a patient who has lost 1000 ml. or even 1500 ml. may appear surprisingly fit and her blood-pressure may be nearly normal. A further relatively small loss may then precipitate severe collapse. The previous blood-pressure

should also be taken into account because if there was hypertension before, a normal reading after bleeding may represent a serious fall. An example of this is seen in cases of concealed accidental hæmorrhage in which a serious degree of shock is often accompanied by a normal blood-pressure and, for reasons that are not understood, a slow pulse. Although in theory it should be easy to estimate the amount of blood lost, in practice it is often very difficult. The blood is frequently mixed with liquor and is absorbed by bed-clothes, towels, pads, swabs and dressings. Because it is so important in assessing the patient to know accurately the amount of blood lost, every effort should be made to collect and measure the blood as it is shed and, by weighing towels and swabs to estimate the blood absorbed in them. When this is done carefully it comes as a surprise to the attendants to know how much blood is lost, even in a normal case from episiotomy wounds, vaginal lacerations and the placental site; and then it is easy to understand how frequently the loss in a patient who collapses is grossly under-estimated. If a patient collapses and the amount of blood lost is estimated to be less than 1000 ml. (1·8 pints) it is reasonable in the absence of continued bleeding to wait 10 to 15 minutes with the patient's head lowered provided that the systolic blood-pressure is above 80 mm. Hg in the hope that the blood-pressure will rise. If, however, it remains below 100 mm. Hg it is probably better to transfuse. If the loss is more than 1000 ml. and the blood-pressure is less than 100 mm. Hg transfusion is indicated; and if the systolic blood-pressure is 70 mm. Hg or less and the patient has a rapid thready pulse, pallor, restlessness and vasoconstriction, transfusion should be begun at once in order to save life. In this case a blood substitute such as dextran or gum-saline will be given while steps are being taken to cross match blood. All patients who lose more than 1500 ml. (2·6 pints) should be transfused even though their general condition and blood-pressure are more or less unaffected. Blood-volume estimates using the dye dilution technique, can be made in assessing the need for transfusion, but they take at least 15 to 20 minutes to perform, and in urgent cases it is better to rely on clinical assessment of the patient and estimation of the amount of blood lost.

The Technique of Blood-transfusion

Cross-matching. All pregnant women should have their blood grouped for ABO and Rh early in pregnancy. In extreme emergency it is reasonable to transfuse a patient with blood that is not cross-matched provided it is of the same ABO and Rh groups as the patient's. If the group of the patient is not known the transfused blood will have to be O Rh negative, but because blood of this group is relatively scarce and much in demand it should not be wasted unnecessarily. In all

other cases blood should be most carefully cross-matched before it is transfused. It is nearly always possible to treat even the most severe cases of blood loss with a plasma substitute while compatibility tests are being performed.

Women who have had previous blood-transfusions or delivered babies who might have suffered from hæmolytic disease should be regarded as potentially dangerous recipients of blood-transfusion, because they may have in the blood-stream circulating antibodies which would react with the appropriate antigen in transfused blood. Extra care should therefore be taken in cross-matching such patients to detect antibodies which, though present in low titre, may yet cause a fatal reaction. A Coombs' test is the most sensitive for detection of these antibodies.

For proper cross-matching it is necessary to supply the laboratory with 4 ml. of oxalated blood and some clotted blood in a dry tube. If dextran is being infused, the blood for cross-matching must be taken before any dextran is given because its presence in the plasma causes rouleaux formation and this interferes with the interpretation of compatibility tests. In urgent cases the tests can be carried out in 30 minutes. First the oxalated blood is used for checking the patient's ABO and Rh groups. Most workers use a tube test; a 2 per cent. suspension of red cells in saline is mixed with an equal volume of each test serum in small tubes; the tubes are centrifuged soon after mixing the cells and serum and the sediment is examined under a microscope for agglutination. The same test can be carried out with less accuracy on a slide or tile. Next, the serum in the clotted sample of patient's blood is matched directly against a 2 per cent. suspension of donor cells in serum-albumin (equal volumes of AB serum and 20 per cent. albumin); the mixture is placed in a tube and incubated for 15 minutes; the tube is centrifuged slowly and the sediment examined under a microscope for agglutination. For non-urgent cases proper cross-matching takes about one and a half hours. The patient's ABO and Rh groups are checked, using the tube test described above, except that mixtures of red cells and test serum are incubated at room temperature and 37° C. for 20 minutes before the sediment is examined. Then the patient's serum is tested directly for antibodies against a suspension of donor cells in saline and incomplete antibodies are detected by an indirect Coombs test. In this test two drops of a 20 per cent. suspension in saline of washed donor cells are mixed with four drops of patient's serum and incubated for 45 to 60 minutes at 37° C. This allows the donor's red cells to absorb on to their surfaces any globulin incomplete antibodies there might be in the patient's serum. After incubation the red cells are washed three times in saline and two drops of a 20

per cent. suspension are mixed on a tile with a drop of antiglobulin serum. If the donor's cells have been sensitized the presence of incomplete antibody will be shown by agglutination, and the time it takes for agglutination to occur will indicate the titre of the antibodies.

Choice of Fluid for Transfusion

Whole blood.—Blood-volume can be rapidly restored by giving blood, serum, plasma, albumin or one of several plasma substitutes. Fresh compatible blood is the ideal substance for this purpose. It has the advantage over other fluids that it remains within the blood-stream longer and by virtue of the red cells it increases the oxygen-carrying capacity of the blood. About 1 per cent. of transfused cells disappear from the circulation daily. In the case of stored blood a percentage of cells equal to the age of the blood in days is haemolysed soon after transfusion. The drawback to blood is that, owing to human fallibility, its great complexity and the tendency for antibodies to be formed against a few of its many antigens, cases of incompatible transfusion occasionally occur and the result may be lethal. Again, blood is not easily obtainable, the supply of donors being limited, and what stores there are should be kept mainly for cases in whom the transfusion of blood is imperative for the saving of life. For these reasons various substitutes can be used. They should be given in emergency when blood is not available and in preference to blood unless the loss of blood is so great that the oxygen carrying capacity is seriously reduced. This is the case when the loss is more than 1500 ml. (2.6 pints).

Plasma.—Next to whole blood plasma is the most efficient substance for restoring circulating blood-volume. Unfortunately there is a risk of homologous serum jaundice following the injection of even very small amounts of plasma containing the virus of serum hepatitis. It is believed that about 1 in 200 donors is a carrier of the virus. In the last war, before it was infused, plasma was pooled from the blood of at least 300 donors (large-pool plasma) and the incidence of hepatitis 3 to 12 weeks after infusion was 10 per cent.; when plasma was pooled from not more than 10 donors (small-pool plasma) the incidence of hepatitis was reduced to 1 per cent. Nevertheless, because some of those cases of hepatitis were so severe as to cause fatal hepatic necrosis, plasma has fallen into disrepute and is seldom used.

Dextran.—This substance is a polysaccharide and the molecules are long chains of glucose units. Solutions with a known molecular size can be prepared. The solution in use in Great Britain has a molecular weight of about 200,000 and a strength of 6 per cent. It is effective in restoring blood-volume although about one-third is removed from the plasma in 24 hours and most within a week. Some is excreted in the

urine, some is metabolized and small quantities are stored in the tissues. It has one or two drawbacks. Its presence in the plasma causes rouleaux formation and therefore samples of blood for cross-matching should be withdrawn before any of it is infused. Allergic reactions occur sometimes, although these are rare when dextran is used for therapeutic purposes. More serious is a prolongation of bleeding time as the result of dextran infusion with a risk of further hæmorrhage due to incoagulability of the blood. This danger seems to occur only after at least 1500 ml. (2·6 pints) of dextran solution have been given and infusions should be restricted to this amount. If the loss of blood has been so large that a greater amount of fluid than this is needed to restore blood-volume whole blood-transfusion is indicated anyway, and there should thus be no need to exceed 1500 ml. of dextran or any other substitute for blood.

Polyvinyl pyrrolidone (PVP or Plasmosan). This is a plasma substitute that can be used instead of dextran, although it is not so well retained in the circulation and therefore is not so efficient at keeping up the blood-volume.

Gum-saline.—A solution of gum-arabic in saline was introduced as a substitute for blood by Bayliss in 1919. As a temporary means of restoring blood-volume it is extremely efficient. In the early days of its use, one or two cases of tetanus occurred as the result of inadequate sterilization, but with modern sterilizing techniques there is no longer any risk of this. It has been shown in animals that gum-arabic remains in the tissues, and especially in the liver, for many weeks after infusion, but no harm to patients has ever been shown as a result. Because of its efficiency in raising lowered blood-pressure and its relative harmlessness compared with other blood substitutes, there seems to be no reason why gum-saline should not be used more frequently than it is.

Rate and Amount of Transfusion

When blood or other substances are being given to restore blood-volume they should be given as fast as they can be made to run into a vein. If possible, in severe cases 1000 ml. is given in 10 to 20 minutes. There is no need to warm the blood. It is best at room temperature but it can be given straight out of the refrigerator. If the blood is heated there is a risk of hæmolysing the red cells. Unfortunately following hæmorrhage the veins go into spasm as a result of the reactive vaso-constriction and it may be necessary to warm the arm in an attempt to relax the spasm. If the operator has difficulty in inserting a needle into a vein he may have to cut down on to one over the internal malleolus of the ankle, on the forearm or in the antecubital fossa. No advantage has been shown in giving an intra-arterial as opposed to an intravenous

transfusion. The transfusion should be continued until the amount of blood lost has been replaced or until the circulatory failure has been relieved, as shown by a blood-pressure of 100 mm. Hg. a fuller pulse and warm skin and extremities. If citrated blood is used the amount of citrate given must not be counted in estimating the total volume of blood given. In a 540 ml. bottle of citrated blood there is 120 ml. of sodium citrate solution and 420 ml. of blood. Thus a patient who has lost 1600 ml. of blood needs four bottles of citrated blood, not three.

When large amounts of sodium citrate are infused rapidly toxic effects may appear. These are an increase in venous pressure, a fall in arterial pressure, muscle twitching or convulsions, cardiac dysrhythmia and changes in the electrocardiograph. These effects are due to a depression of the ionized calcium in the extra-cellular fluid which causes pulmonary vaso-constriction and loading of the right ventricle and later has a direct toxic effect on the myocardium. Citrate is normally removed from the circulation by renal excretion and by breakdown in muscles and in the liver. Unless there is liver disease a woman can tolerate the transfusion of a pint (540 ml.) of citrated blood in the space of 5 minutes without showing the signs of citrate intoxication. If a high plasma citrate level is suspected 10 ml. of 10 per cent. calcium gluconate or 10 per cent. calcium chloride should be injected into a vein. This solution must not be put into the transfusion bottle or tubing because of the danger of coagulation.

Care should be taken not to overload the circulation by over-transfusing or pulmonary oedema may supervene. In some obstetric units a rapid estimate of the circulating blood-volume is made using the dye solution technique in order to decide on the amount of blood needing to be replaced, but this method takes a certain amount of time with delay in treatment, and is not generally used.

Untoward Effects of Blood-transfusion

Hæmolytic reactions.—Excessive hæmolysis of donor's cells may occur as the result of the transfusion of incompatible blood, of old stored blood or of blood that has been over heated. The temperature rises during transfusion and there is often a rigor. The patient may complain of pain in the chest and lumbar region, of headache, dyspnoea, cyanosis and of feeling faint. Later urine secretion may be suppressed and jaundice may develop. Hæmoglobinæmia and hæmoglobinuria are found. Renal failure may be the cause of death after several days. One advantage of rapid compared with slow transfusion is that the reaction produced, if the blood is incompatible, is much more acute and almost invariably leads to the stopping of the transfusion before too much harm has been done. It is a good precaution in all cases of

blood-transfusion to begin the transfusion rapidly to see if a reaction is produced. A sample of the patient's blood and a few ml. of donor blood should always be kept in a refrigerator for 24 hours after a transfusion for further investigation in case there should be a reaction.

Febrile reactions.—These are fairly common and are due to pyrogenic products of bacterial growth in the anticoagulant, in the blood or in the apparatus. The temperature rises toward the end of the transfusion and usually settles within a few hours.

Allergic reaction.—Urticaria, œdema of the face or bronchial spasm may occur, especially in patients who are known to be allergic to pollen, dust, etc. These reactions are seldom severe. They are believed to be due to antigens in the transfused plasma.

Septicæmia.—The transfusion of infected blood may lead to a fatal septicæmia. The risk is increased by the use of old stored blood from which samples for cross-matching have been withdrawn, and when the blood has been allowed to remain at room temperature for any length of time. The organisms are usually pseudomonas or coliforms. New sterilizing techniques have reduced the risk of blood becoming infected.

Homologous serum jaundice.—Although the incidence of hepatitis is much less after the transfusion of whole blood than it is after giving pooled plasma, there is a small risk of the order of 0.5 per cent.

Thrombophlebitis.—When an infusion is kept up for many hours thrombophlebitis of the vein that is being used commonly follows. This is more frequent after the use of rubber tubing than of plastic tubing.

Air embolism.—This may occur if the level of blood in the bottle falls below the top of the outlet tube, especially if positive pressure is being used because of venous spasm; or if, in the course of changing over bottles of blood, air is permitted to enter that tubing.

Rh Sensitisation.—Even today Rh negative patients are seen who have been transfused with Rh positive blood, often unnecessarily, only to develop antibodies as a result. Since there is a 50 per cent. chance of sensitization each time a Rh negative woman is transfused with Rh positive blood, the result on future pregnancies is liable to be disastrous.

Citrate intoxication.—When citrated blood is transfused more rapidly than one pint in 5 minutes there is a rise in the plasma citrate level and toxic effects are seen. Hypotension, cardiac dysrhythmia, muscle twitching and convulsions occur. There is pulmonary vasoconstriction and myocardial inefficiency as shown by an increase in the venous pressure and changes in the electrocardiograph. These toxic effects can be abolished by the injection into a vein of 10 ml. of 10 per cent. calcium gluconate or 10 per cent. calcium chloride or 0.25 per cent. procaine solution at a rate of 30 drops a minute.

CHAPTER XLVI

VITAL STATISTICS

Maternal Mortality

For many years and in many countries the success of the work done by the Maternity Services has been assessed by what are known as vital statistics. Indeed most Obstetric Hospitals and Departments publish annual reports and in these comparisons are made with greater or less satisfaction with comparable figures that are offered by neighbouring or rival institutions. Whereas it is probably true that such statistics present an overall and fairly accurate picture of the efficiency of the service it would be very wrong to suppose that they are free from error. When the numbers are relatively small and if the hospital registrar responsible for their compilation has been liberal in the use of what is popularly known as "adjustment", the mistakes are indeed serious and the alleged results entirely misleading. None the less, every one who practises obstetrics should be familiar with the general trend and have knowledge of the changes that have occurred in the maternal and foetal mortality in recent years.

Three hundred years ago, in 1660, the maternal mortality rate in London was about 1 in 40 births and 100 years later only about half that figure. A century ago a distinct improvement had occurred as only about 1 : 200 women died in childbirth.

The maternal mortality rate is expressed as the number of maternal deaths per 1000 live or still births. This figure has been published annually in Britain by the Registrar-General for about the last 100 years. The rate will vary as to whether deaths due to abortion are included and to be strictly accurate the figure should be that of the number of women who in any given year died from any maternal cause. This figure, however, cannot be calculated unless every pregnancy (and therefore every abortion) has been notified and such a procedure will never be possible. Thus it is that all calculations are based on the number of births (which are notifiable) and for practical purposes of comparison and progress this method is reasonably satisfactory. In the recently published Confidential Enquiry into Maternal Deaths in England and Wales, deaths from abortion and those which followed anaesthesia have been included making the picture more realistic. In some countries the stillbirth rate may be unknown and the maternal mortality rate is estimated on the registered live births. The Confidential Enquiry for

another reason presents a more accurate account, for many women die in pregnancy who are undelivered and these cases are likely to be missed in any series based on actual birth of a baby. The possibility for further inaccuracy has been also demonstrated in the much more complete investigation in the Confidential Enquiry referred to above, in that maternal deaths could be, and have been wrongly ascribed to some complication of pregnancy or childbirth when such deaths have occurred after a very long interval has elapsed following the pregnancy and confinement.

Another large and important group of cases is unlikely to have been, or to be, included in most statistics of maternal mortality. This group includes a number of deaths which have been certified and accurately certified as due to other conditions, such as heart disease, diabetes, etc. Pregnancy may not have been mentioned at all on the death certificate. It thus comes about that the results obtained in any Confidential Enquiry are likely to be far more reliable than those furnished by the usual and official vital statistics.

The reader should be interested in the figures available from countries in other parts of the world and these are shown in Table I

TABLE I

MATERNAL MORTALITY RATE (INCLUDING ABORTION) PER 1000 LIVE BIRTHS
VARIOUS COUNTRIES, 1953

Australia	0·6	Sweden	0·6
Canada	0·8	Switzerland	1·2
Denmark	0·8	Union of South Africa ¹	1·2
Irish Republic	1·3	United Kingdom	
Netherlands	0·8	England and Wales	0·8
New Zealand	0·5	Northern Ireland	0·6
Norway	0·7	Scotland	0·9
		United States of America	0·6

¹ White population

In England and Wales from the time of the commencement of the figures for maternal mortality until about 1935 very little variation occurred and the rate fluctuated between 5 and 4 per 1,000. Throughout the later years of this period when more accurate analysis was possible, the chief cause of death consistently was puerperal sepsis. Since 1935 a very notable decrease in puerperal sepsis followed an observed diminution in the pathogenicity of the hæmolytic streptococcus reinforced twelve months later by the advent of the sulphadiazine drugs and nearly eight years later by the discovery of penicillin. The changes are represented in Fig. 246.

During the last decade an even more searching and informative enquiry has been conducted into maternal mortality. The findings on

the first 1,000 deaths, recently published by the Ministry of Health,¹ show an entirely altered picture to that which existed twenty years ago. In the first place the maternal mortality has dropped from 4.6 per 1000 (1935) to 0.47 per 1000 (1957). In 1935 puerperal sepsis alone accounted for 2.0 out of 4.6 per 1000 cases, whereas in the series just mentioned

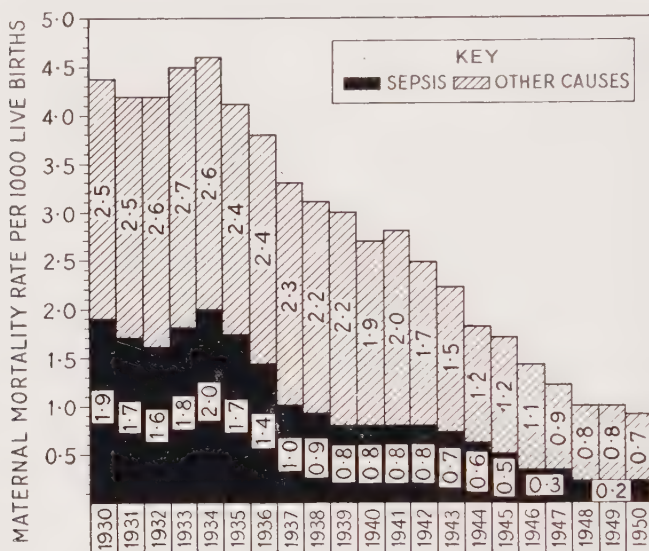


FIG. 246.—MATERNAL MORTALITY FROM SEPSIS AND OTHER CAUSES.

this disease was responsible only for a mere 4 per cent. of the total. The five chief causes of maternal death as shown in the Confidential Report were :

	<i>cases</i>	<i>per cent. of the total</i>
Deaths due to toxæmia (including toxæmic antepartum hæmorrhage)	246	22
Deaths due to hæmorrhage (excluding toxæmic antepartum hæmorrhage)	188	17
Deaths due to abortion	153	14
Deaths due to pulmonary embolus	138	13
Deaths due to cardiac disease	121	—

For some years there has existed a growing appreciation of maternal death associated with cardiac disease. More important causes vary with increasing age and increasing parity. This is illustrated in the case of pre-eclamptic toxæmia and hæmorrhage.

¹ Report on Confidential Enquiry into Maternal Deaths in England and Wales 1952-1954. London. H.M. Stationery Office.

TABLE II

MATERNAL MORTALITY RATES (INCLUDING ABORTION) PER 1000 BIRTHS,
LIVE AND STILL, ACCORDING TO AGE: ENGLAND AND WALES, 1954-55

<i>All ages under 20</i>	20	25	30	35	40	45 <i>and over</i>
0.67	0.41	0.37	0.46	0.77	1.26	2.37
						13.03

TABLE III

MATERNAL MORTALITY RATES (INCLUDING ABORTION) OF MARRIED WOMEN
PER 1000 LEGITIMATE MATERNITIES, ACCORDING TO NUMBER OF PREVIOUS
CHILDREN: "ENGLAND AND WALES, 1946-49

<i>Number of previous children</i>													
<i>Total</i>	0	1	2	3	4	5	6	7	8	9	10	11	12 <i>and over</i>
1.13	1.18	0.84	1.05	1.30	1.61	2.06	1.80	2.20	2.01	3.11	3.34	5.08	7.22

This is illustrated in the case of pre-eclamptic toxæmia and hæmorrhage (see Fig. 247 and Fig. 248).

The Confidential Enquiry has brought to light other facts which have increased our knowledge of the contributory causes to maternal deaths during the years under review. Thus although the amount and standard of antenatal care has increased enormously over the last two decades faulty antenatal care in the case of pre-eclampsia was by far the most serious and most frequent avoidable factor. The need for immediate hospitalization for the purpose of observation and rest is imperative. The patient herself provided an avoidable factor in an appreciable number of cases in that she refused the advice that was given, or that she failed in her routine attendance for examination during pregnancy. The latter demands an immediate investigation in order to ascertain the reason and this should be made by a personal visit by a responsible person rather than by postal enquiry. Death from hæmorrhage presented a very similar picture. In addition, it would appear that full use in this condition was not always made of the services of the Obstetric Emergency Teams (Flying Squads). This resulted in the wrong management of several cases whereby patients who were extremely ill through loss of blood were despatched by ambulance to hospital to arrive there either moribund or dead. In other instances there appeared to be a lack of appreciation of the risk of moving a patient to hospital with the placenta undelivered.

In the case of abortion the two chief causes of death were from sepsis when the abortion had been procured by instrumentation and from air embolus which followed the injection into the vagina of fluid under pressure.

Deaths from cardiac disease came fifth on the list of causes and here again the wisdom of insistence that all such patients should arrange for their confinement at hospital became obvious. The absence of

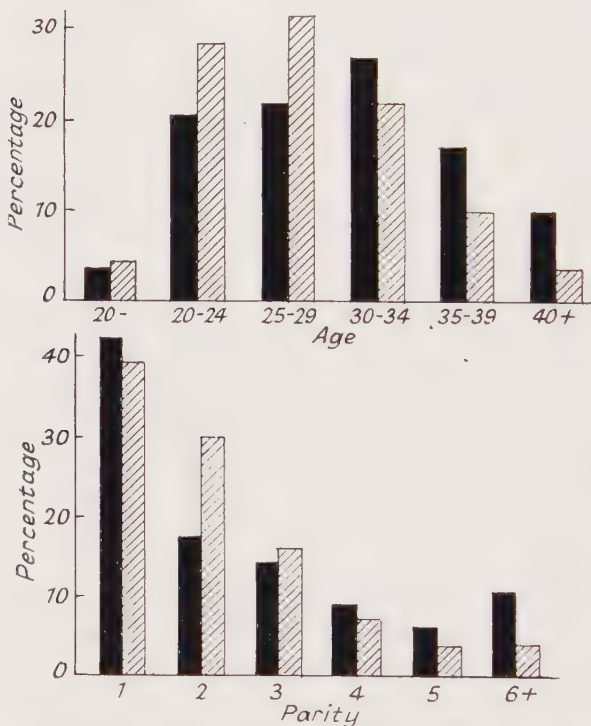


FIG. 247. —PERCENTAGE DISTRIBUTION OF MATERNAL AGES AND PARITY IN DEATHS DUE TO PRE-ECLAMPTIC TOXÆMIA.

expert medical advice or of a period of rest before labour started were certain and serious contributory causes to the woman's death. Often such advice had been given to, but had been refused by, the patient. Some of these patients failed in their regular attendance during pregnancy. Many were multiparous women who, not unnaturally, concluded that because they had survived previous confinements therefore the present pregnancy and labour would also be equally straightforward. In some instances it appeared that a similar mistake was made by these patient's doctors. The fact that 185 deaths followed Cæsarean section and that over half of this number were certified to have been due to

hæmorrhage, shock or collapse demands attention. It appeared that in a number of cases insufficient attention was given to the grave condition of the patients prior to operation and to the large amount of blood lost during and after the operation. In others the operation was performed in small maternity homes, where the replacement of blood-loss presents very great, or almost insuperable, difficulties, which are not likely to exist in any large unit.

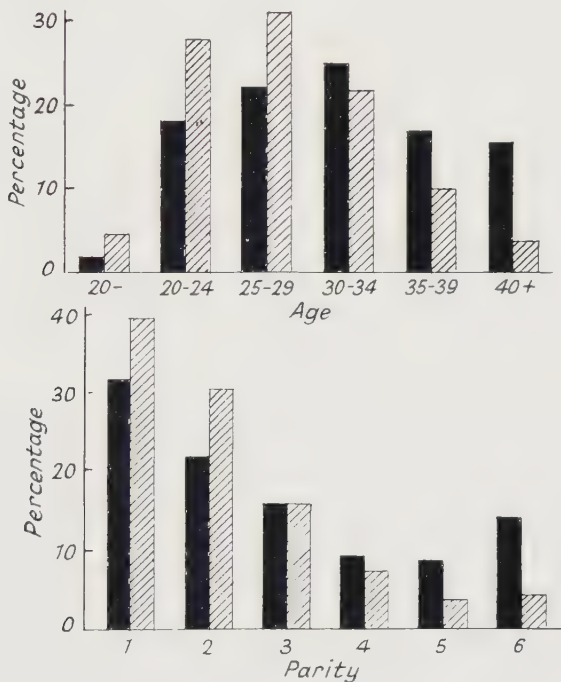


FIG. 248.—PERCENTAGE DISTRIBUTION OF MATERNAL AGES AND PARITY IN DEATHS DUE TO HÆMORRHAGE.

Therefore, there would appear still to be many ways in which childbirth can be made more safe and even though the maternal mortality has reached the very low figure of 0.47 per 1,000 the Confidential Enquiry showed that in nearly half the deaths an obvious avoidable factor was present. It is probable, therefore, that with an inevitable increase in our knowledge, childbirth will become even more safe as the years pass. Just as in 1935 a possible maternal mortality rate of 0.5 per 1,000 for 1960 was then considered as a most unreasonable estimate, so today the suggestion that in twenty or thirty years time the maternal death rate might be only 5 per 100,000 births would surely be regarded as ridiculous.

The Decrease in Maternal Mortality

Mention has already been made of the disappearance in 1935 of the pathogenicity of the hæmolytic streptococcus. During the last twenty-five years many other factors have made their contribution toward safer childbirth. There has been the discovery of the sulpha drugs and antibiotics, the perfection of technique and organization of blood-transfusion, some improvement in methods of anæsthesia and analgesia, a better appreciation of the maintenance of the general health of the woman in pregnancy, the better education in obstetrics of medical students and pupil midwives. Other factors which undoubtedly play their part are such matters as the rising standard of living, the slow improvement in housing, and the determination of the great majority of women that provision shall be made for their confinement, to take place in hospital.

In all these matters, and certainly in the co-ordination of the maternity services, there is still room for great improvement. As all this comes to pass it will doubtless be accompanied by ever more gratifying results.

Infant Mortality

The Infant Mortality is expressed as the number of deaths in children under the age of one year per 1000 live births occurring during the first year of life. The obstetrician is, however, most concerned with the number of babies born dead—stillbirth—and the number that die during the first week after birth—neonatal death. The figure for these two when added together is now known as the *perinatal* death rate and this figure, together with maternal mortality, is used to watch the success of the Maternity Services.

The trend of Infant Mortality is shown in Fig. 249.

The term *neonatal mortality* denotes deaths occurring during the first four weeks after birth and while not the same as perinatal mortality (death occurring within 7 days) can be taken as a figure which may illustrate what is happening in the country year by year.

That the improvement has been considerable, indeed almost dramatic, is shown in Table IV though the neonatal mortality rate can only be followed since 1920. In 30 years, however, the figure has been reduced to one-half of the original. The analysis of the causes of the perinatal mortality is not nearly so accurate as is the case of maternal mortality. A nation wide Confidential Enquiry, owing to the greater numbers involved, would inevitably throw a very heavy burden on the Maternity and Administrative Services. But an even more emphatic deterrent is our lack of knowledge at the present time

of the real cause of stillbirth and neonatal death in the majority of cases. Post-mortem examinations have been performed far too seldom and in most instances far too perfunctorily. The individual labours of a

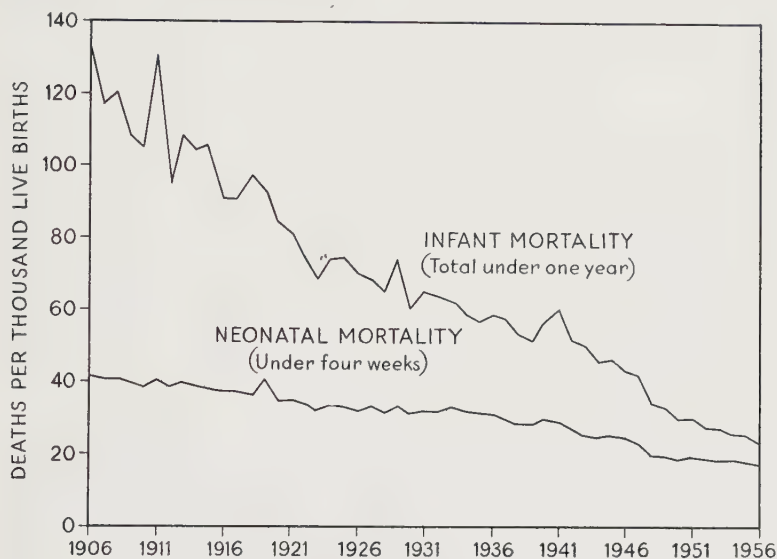


FIG. 249.

very few enthusiasts have begun to draw aside the curtain of ignorance, but the field for research on these matters must be enormous both in its scope and its interest ; its national importance is obvious.

TABLE IV

INFANT MORTALITY RATES (DEATHS UNDER ONE YEAR PER 1000 LIVE BIRTHS) FROM 1841 TO 1955. NEONATAL MORTALITY RATES (DEATHS UNDER 4 WEEKS PER 1000 LIVE BIRTHS) FROM 1911 TO 1955: ENGLAND AND WALES

	Infant Mortality Rates			Neonatal
	Both sexes	Male	Female	Mortality rates Both sexes
1841-50	153	167	137	—
1891-1900	153	168	138	—
1901-10	128	140	114	—
1911-20	100	112	89	38
1921-30	72	81	63	33
1931-40	59	66	51	30
1941-50	43	48	38	24
1940	57	64	49	30
1945	46	51	40	25
1950	30	33	26	19
1955	25	28	22	17

A similar, and in many instances more pronounced, drop in the infant mortality has occurred in other parts of the world.

TABLE V
INFANT MORTALITY RATES IN VARIOUS COUNTRIES

	1936-38	1948	1955
Australia	39	28	22
Canada	68	44	31
Denmark	64	35	25
Netherlands	38	29	20
New Zealand (excluding Maoris)	33	22	22
Sweden	44	23	17
England and Wales	56	34	25
Northern Ireland	76	46	32
Scotland	77	45	30
United States	54	32	27

While it may be possible to accept any rise or fall in the infant mortality rate on a national basis it would be foolish to use such figures as a final assessment to compare the efficiency of various hospitals or obstetric departments. In a comprehensive investigation into the causes and prevention of perinatal mortality¹ as long ago as 1952 Baird wrote "The most important fact . . . is that stillbirths and first week deaths fell abruptly in many populations throughout the world in the war years. Such sudden and widespread effect cannot be attributed to the application of new medical skill. . . . A large proportion of obstetric death was and still is due to vague and ill-defined conditions, which so far as present knowledge goes, point to 'physiological failure' of the organism during pregnancy. Such conditions would be expected to become less with improvements in the nutritional and general health of women, not merely during pregnancy, but during growth and adolescence. The vital statistics (considered in their paper) suggest that, in fact, the elimination of the grosser forms of poverty, together with the provision of assured supplies of inexpensive and nourishing foods to expectant mothers in the United Kingdom was accompanied by a remarkable reduction of obstetric deaths mainly those from ill-defined causes. . . . The age and parity composition of population plays a considerable part in determining obstetric mortality. Therefore, if the effects of social conditions on the obstetric death-rate are to be studied accurately, the age and parity groupings must be

¹ The Causes and Prevention of Stillbirth and First Week Deaths. Ethel H. L. Duncan, Dugald Baird, and A. M. Thomson. *J. Obst. and Gyn. Brit. Emp.*, 1952, **59**, 183.

known and allowed for. For comparison between cities, and particularly between hospitals in which patients may be highly selected, it is necessary not only to know the age and parity distribution but also something about the social background of the mothers. To take an extreme case, an expensive private nursing home may take in a majority of primigravidæ of whom many are 'elderly' though in comfortable circumstances, whereas a free hospital in an industrial city may take in many slum dwellers with a high proportion of young primigravidæ and women of high parity. The kind of patient dealt with may determine the mortality experience in each institution just as much as the quality of the care provided." This though written in 1952 has been confirmed in the following years not only by further work by Dugald Baird and his colleagues, but by many other observers in this country and elsewhere in the world. The quotation has been made at length because it sums up so completely the complexity of the problem and explains so clearly the many factors which must be taken into account in the compilation and in the interpretation of all vital statistics.

Several factors seem to influence infant mortality, which, for some unknown reason appears to be highest from every cause in male babies. In the neonatal period the mortality-rate is considerably higher in illegitimate infants, which is hardly surprising as the mothers of such children are not likely to be drawn from the most healthy grades, either physical or mental, of society.

Maternal age and parity, as has been already mentioned, have repeatedly been shown to exert their influence. Thus after the fourth pregnancy the infant mortality shows a definite rise. The association with the maternal age is a more difficult problem, as it is complicated by the effect of the social class. In the lower strata of society marriage and childbearing take place at an earlier age whereas the maternal general health is likely to be of a higher order in the more wealthy. This tends to be offset by the disadvantages of embarking on a family at a later period of life.

It is usual to attempt to explore the problem of perinatal mortality by a survey of the causes of death, but for reasons just given the results so far have been both disappointing and, because of lack of information, inaccurate. Certain conditions do, however, stand out as important. Thus in England and Wales in 1955 the leading causes of postnatal mortality (death in the first 12 months) are shown in Table VI. These figures can, however, only be used as the roughest of guides. In the first place the cause of death as stated on the death certificate will be made in the huge majority of instances without any postmortem examination, and when such an examination has been done it will only very seldom be of any assistance. There is also a natural variation in

the opinions held by the many doctors who make the certification and indeed in the opinion of every individual doctor as the years pass by. Certain diseases gain and lose popularity.

TABLE VI

LEADING CAUSES OF INFANT MORTALITY, ENGLAND AND WALES 1955
(Rates per 1,000 Related Live Births) Postneonatal
(4 weeks to 1 year)

Bronchitis and pneumonia	2·8
Congenital malformations	1·8
Gastro-enteritis	0·6
Accidental mechanical suffocation	0·5
Meningitis	0·2

When the figures are broken up into the supposed cause of death in the first 4 weeks (neonatal mortality) and in the ensuing 11 months the chief causes of neonatal mortality would appear to be :

(England and Wales 1950 rates per 1000 live births)

1. Immaturity	5·8
2. Asphyxia and atelectasis	3·3
3. Congenital malformation	2·7
4. Injury at birth	2·6
5. Respiratory tract infection	1·5

CHAPTER XLVII

CARE OF THE NEWBORN INFANT

UP to the moment of delivery, the foetus lives a parasitic existence. The placenta "breathes, digests and excretes" for the foetus and permits the vital functions of respiration and digestion to remain latent. Protection against trauma, infection and heat loss is afforded by the surrounding maternal tissues.

Survival and growth are dependent upon an intact placental circulation, but, with the moment of delivery, the infant is launched on an independent existence and must assume these vital functions or die. This necessitates profound physiological changes in the infant immediately following the traumatic experience of birth.

The first and most important alteration is in cardio-respiratory function while changes in the other bodily systems occur in a more leisurely fashion.

Changes in the Respiratory System.—It has been demonstrated that the foetus *in utero* rehearses the movements of respiration to a point just short of expansion of the chest and lungs. These respiratory movements are phasic and are interrupted by long periods of rest. Amniotic fluid is drawn in and out of the nasopharynx and the bronchial tree during intra-uterine respiratory movements and this may assume great importance when extra-uterine respiration is initiated. It assumes especial importance when foetal distress has occurred and meconium has been expelled into the liquor amnii.

It is uncertain what particular stimuli are responsible for the initiation of respiration after birth. Once labour has begun the uterine contractions probably produce a relative anoxia in the placental circulation. This anoxia and the associated rise in CO_2 concentration possibly sensitize the foetal respiratory centre, but respiratory movements are held in abeyance, possibly by the action of contracting uterine muscle on the body of the child when the membranes have been ruptured. With the more sustained contractions of the second stage, the respiratory centre is further stimulated by the induced anoxia.

Once the baby is born the body can uncoil from the foetal position and the straightening of the spine and the change in shape of the chest and position of the diaphragm facilitate respiration. The fall in body surface temperature after delivery is probably an added stimulus to respiration.

Some combination of these factors is held responsible for the initiation of full respiration. It must be remembered that any sedative or anæsthetic administered to the mother is shared by the foetus and may depress the respiratory centre which is then less ready to respond to such stimulation.

In normal circumstances the first breath draws air into the bronchial tree and the lungs, unless there is obstruction from liquor amnii or mucus. With successive respiratory movements the thoracic cage expands and creates a negative intra-pleural pressure. The difference between this intra-pleural negative pressure and the atmospheric pressure of the air in the bronchial tree causes the solid foetal lung to expand by entry of air into the alveoli. This alveolar expansion is at first rapid, but several hours elapse before complete expansion of the lung occurs, especially at the lower lobes.

Although the first breath is usually taken immediately after birth, respiration may be suspended for many minutes, but the newborn infant appears to be less susceptible to the ill-effects of prolonged anoxia than is the adult.

Changes in the Cardiovascular System.—The foetal circulation differs from that of the adult in several important respects, which appear to be aimed at holding the respiratory function in abeyance.

*Fœtal circulation.**—From the placenta, foetal blood receives oxygen and nutriment which is carried back to the foetus by the umbilical vein. On entering the body of the infant the vein divides, one branch carrying blood to the liver and thence to the hepatic vein and inferior vena cava, while the other branch carries oxygenated blood directly to the inferior vena cava through the ductus venosus. Only a small proportion of the blood entering the right auricle from the inferior vena cava passes to the right ventricle and the pulmonary circulation, as the lungs require little blood in their unexpanded state. The main volume of blood passes from the right auricle to the left auricle through the foramen ovale and thence to the systemic circulation through the left ventricle. A second by-pass exists in the patent ductus arteriosus which deviates blood from the pulmonary artery to the aorta. These shunts or by-passes deviate blood from the unexpanded lungs and ensure a rich supply of oxygenated blood to the head and neck and to the remainder of the body. The hypogastric arteries arise from the internal iliac arteries and terminate as the umbilical arteries which carry de-oxygenated blood back to the placenta.

Changes in fœtal circulation at birth (See Chapter V, p. 42).—The occlusion of the umbilical vessels and the onset of respiration

* The reader is also referred to Chapter V, p. 41.

cause functional changes in the circulation which are followed after a variable interval by anatomical changes.

The umbilical cord desiccates and separates leaving a raw area which heals by granulation and is covered by epithelium. The umbilical vein is now a redundant vessel and closes by aseptic thrombosis. The ductus venosus atrophies and disappears while the umbilical vein remains as the ligamentum teres. The umbilical arteries show retrograde closure as far as the hypogastric arteries and persist as sclerosed remnants.

The drop in pressure in the right side of the heart which is created by the expansion of the lungs and opening up of the pulmonary circulation is responsible for the obliteration of the foramen ovale. The same factors are probably responsible for the functional closure of the ductus arteriosus. This functional closure may be due to a valve-like action in the aortic wall or to a torsion of the ductus, but results in the separation of the systemic and pulmonary circulations. The ductus arteriosus is anatomically obliterated by endarteritis after one month although the persistence of a patent ductus arteriosus is a not uncommon congenital cardiac malformation in adult life.

These changes in the foetal circulation ensure that the total circulating blood passes through the lungs and is returned, fully oxygenated, to the left side of the heart to supply oxygenated blood to all tissues of the body.

Changes in the Gastro-intestinal Tract.—Although it has been stated that the placenta digests and excretes for the foetus, the gastro-intestinal tract is active during intra-uterine life. Liquor amnii contains lanugo, hair and epithelial cells shed from the foetal skin. During the later months of pregnancy, liquor is swallowed by the foetus. Mucus and debrided intestinal epithelium are added to the gut content and, with the swallowed liquor, are digested by intestinal ferments to create meconium. The greenish black colour of meconium is due to bile pigments. The meconium has traversed the gut as far as the rectum by later pregnancy, and, if strong intestinal contractions are stimulated during labour by foetal distress, and the sphincters are atonic or paralysed, meconium may be voided into the amniotic fluid. This may cause respiratory difficulties if premature respiration is also induced, and meconium-containing liquor is inhaled into the bronchial tree.

With the first inspiration, air enters the stomach and rapidly traverses the gut.

The hydrochloric acid content in the stomach is relatively high on the first day of life, but is present in only moderate amounts during early infancy.

Amylase from the salivary secretion and from the pancreas is at a low level during the early weeks of life and this explains the difficulty in digesting starch which may be met in some infants.

The trypsin and lipase of pancreatic secretion are present in good concentration, even during intra-uterine life and are responsible for the digestion of meconium.

The Genito-urinary Tract.—The removal of foetal metabolic end products is achieved mainly by the placenta. The kidneys are active, however, during the later months of pregnancy and urine is excreted into the amniotic fluid. Obstructive anomalies of the urinary tract may produce hydronephrosis which is demonstrable at birth.

Regulation of the Body Temperature.—The foetal temperature is probably dictated by the temperature of the surrounding maternal environment, and control by the infant's heat regulating centre is dormant. After birth, unless special precautions are observed, the infant's temperature falls by 2° to 5° F. and external heat must be supplied. After a few days the temperature regulating centre becomes effective and the infant's temperature is kept normal despite environmental variations in heat.

Defences against Infection.—Placental transmission of antibodies present in the maternal serum affords the infant a non-specific passive immunity against certain diseases. This immunity wanes after a short period and the infant is at risk from common infections until an acquired immunity is developed. The immunity may be specific against infectious diseases from which the mother has suffered and against which she has developed an active immunity.

Causes of Neonatal Mortality.—The causes of death within the first month of life may be classified under the following heads:—

1. Congenital malformation incompatible with life, although some deformities are remediable by surgery.
2. Failure of adaptation of the infant to an independent existence. Cardio-respiratory adaptation of function is immediately urgent and changes in other systems may be delayed.
3. Prematurity and immaturity with the added hazards to the life of an individual not yet ready for independent life.
4. Trauma induced by the act of birth.
5. Failure to establish nutrition and normal digestion.
6. Infection.

The normal healthy infant spontaneously undergoes the physiological changes which permit independent life and the immediate care of the newborn must be directed to encouraging these changes to take place; to remedying any factor which may prevent these adjustments; and to the appreciation and correction of any malformation or traumatic effect which will endanger the life of the infant.

The following paragraphs detail the care which is necessary for the healthy infant, and, in subsequent paragraphs, the deviations from normal which may arise and the measures by which they should be corrected.

THE IMMEDIATE CARE OF THE HEALTHY INFANT

As soon as the head is delivered, the eyelids should be wiped with a dry sterile wool swab to remove the vernix caseosa and blood.

When the body is delivered, the infant is limp, with only moderate muscle tone, and shows purplish blue cyanosis of a general distribution. Liquor drains from the nose and mouth and to assist this drainage the

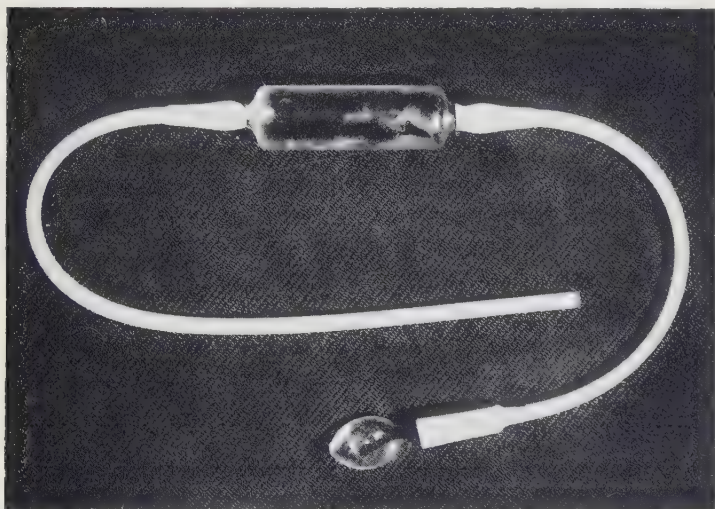


FIG. 250.—CATHETER FOR THE ASPIRATION OF FLUID FROM THE PHARYNX.

infant should be inclined head downwards with the arms extended above the head. The mouth should not be cleaned with gauze swabs as this will cause damage to the delicate buccal mucosa.

The nose and next the nasoxopharynx may be cleared of fluid with a sterile mucus-catheter. The type illustrated (Fig. 250) is made of rubber tubing with a glass fluid trap and mouthpiece. Metal mucus-catheters should not be used as the tip of the metal tube may damage

the pharyngeal wall. The tubing must be made of soft rubber and the catheter must include a chamber to trap the aspirated fluid. This prevents the individual using the catheter from sucking the fluid directly into the mouth.

As soon as the nasopharynx has been cleared of liquor amnii and mucus the infant will normally take a breath and give a cry, and, as respiration commences the colour of the skin rapidly changes from a deeply cyanotic to a pink colour. Cyanosis of the extremities may persist for a longer period, but this is not usually of pathological significance.

Care of the Eyes.—In the past it has been the custom to instil one drop of 1 per cent. silver nitrate solution into each eye after delivery as a prophylactic against conjunctival infection, especially gonococcal, in cases in which maternal infection exists. Most institutions have now abandoned this practice on the grounds that it is unnecessary and that the antibiotics offer a more efficient therapy which can be applied immediately if infection should occur. Silver nitrate solution may itself cause a non-specific irritation or cloudiness of the cornea. In other institutions penicillin eye drops (2,500 units per ml.) are used instead of silver nitrate solution and are instilled into the eyes immediately after birth.

The use of prophylactic drops is probably unnecessary unless there are special indications. Daily wiping of the eyes with wool soaked in normal saline is a common practice which is not desirable and may predispose to a pyogenic conjunctivitis. The eyes of the newborn infant should not be treated unless infection occurs.

Ligation of the Umbilical Cord.—The umbilical cord is now tied about 6 inches from the umbilicus and a pair of artery forceps applied a short distance away on the maternal end of the cord. The cord is cut between the ligature and the forceps and the end covered with sterile wool. It is debatable whether the cord should be tied immediately, or delayed until cord pulsation has ceased. Delay in tying probably increases the infant's blood volume by 30-60 ml. It is claimed that this umbilical transfusion is beneficial by increasing the store of iron reserves in the body, but increases the number of red blood cells which are hæmolyzed during the first week of life and the likelihood of physiological jaundice.

The cord ligature is made of several strands of twisted stout linen thread tied with a reef knot. The ligature should be tight enough to occlude the blood-vessels, but should not cut the cord. A fleshy thick cord will rapidly shrink in diameter and the ligature become loose.

Examination of the Infant.—Inspection of the infant will reveal any gross congenital abnormalities. It is advisable to carry out this examination in a systematic fashion, beginning with the head and inspecting the whole surface of the body. The inside of the mouth should be inspected to detect a cleft palate. The anus should be examined to exclude imperforate or ectopic anus. Careful note must be taken of any birthmarks or nævi which are present, or supernumerary digits. Further points on the complete physical examination of the newborn infant are discussed in Chap. XLIX.

General Care of the Baby.—The baby is wrapped in warm towels and blankets and placed head down in a crib tilted to an angle of not more than 15°. The baby is kept under observation and the air passages sucked free of secretion when necessary. Continuous respiration and crying must be encouraged.

Once the respirations are well established, the baby may be shown to the mother. After the infant has been handled by the mother he should be returned to his cot and kept warm. From time to time the cord should be inspected to ensure that shrinkage of the fleshy cord has not permitted the ligature to become loose with risk of hæmorrhage from the cord.

The Baby's Bath.—At birth the infant is covered with greasy vernix caseosa and blood. Vernix is difficult to remove with water, but comes off with olive oil applied on wool swabs. The baby is usually bathed after the first hour or two and dressed after the cord has been treated. This bath is commonly repeated each day and the cord treated at the same time if a cord powder is used.

The first bath should be omitted if the infant is suffering from shock or trauma, or if his condition is not entirely satisfactory. No harm will result from this failure to remove the vernix which will peel off within a few days without becoming offensive or infected. It is believed in some maternity units that daily bathing predisposes to skin sepsis. Excess vernix is removed after birth and the baby is bathed only on the day before discharge from hospital. This may become the practice of the future.

After the bath the baby's skin should be dried by dabbing with a soft towel, as any vigorous rubbing will damage the soft and moist skin. The baby should be weighed naked and the weight recorded.

After the bath the cord should be ligated for the second time. The ligature should be applied about half an inch from the umbilicus and the cord cut to a length of 1 inch. The stump may be covered with cord powder and wrapped in a linen dressing held in place by a binder.

A simple cord powder may be made of 3 parts of talc to 1 part of zinc oxide. A collodion seal has been used in place of cord powder. The raw end of the umbilicus is covered with collodion which dries and hardens, sealing the cut surface, but leaving the stump of the cord free to desiccate. The use of collodion obviates the need for a linen dressing and binder, which are often soaked with urine from the napkin, with risk of infection. The collodion seal renders a binder unnecessary to the great advantage of the infant since the binder is only too frequently applied in such a way that it hinders and embarrasses abdominal respiration and the comfort of the infant. It is doubtful whether this practice significantly reduces the risk of umbilical infection.

The stump of the cord desiccates and separates between the 4th and 11th days, usually on the 6th or 7th. The raw area of the navel heals by granulation and ingrowth of epithelium and leaves a puckered scar.

Identification.—In institutions it is most desirable that the infant should be identified by some name tape or other mark of identity. This may be a necklet of lettered beads spelling the baby's name, or a piece of tape sewn round the infant's ankle or wrist with the name marked in indelible ink. Whatever the method of identification employed it is essential that every baby in a maternity unit should be identified in such a way that confusion between babies cannot arise.

Dressing the Baby.—After the bath the baby should be clad in a soft woollen vest, a napkin and a dress. Any shawl or blanket should at first be wrapped loosely around the infant to permit freedom of movement. The body temperature must be maintained for the first few hours by clothing and coverings, raised room temperature and hot water bottles in the cot, shielded from the infant. Subsequently, when the temperature regulating mechanism is active, the clothing and the room temperature must be adjusted to the needs of the baby, and in accordance with the atmospheric temperature. Socks and gloves may be added to the clothing when the baby is exposed to a normal room temperature.

Examination of the Newborn Infant.—At the earliest convenient moment after the birth of the infant a systematic physical examination should be carried out. External examination is of great importance and attention should be given to the presence of minor congenital defects. Skin nævi, pre-auricular sinus, branchial fistulæ, supernumerary digits and nipples should all be looked for and a careful note made of their presence. Eye defects such as conjunctival hæmorrhages; the presence of hare lip and cleft palate, spina bifida

and club feet may escape notice if of minor degree and especial attention should be given to possible omphalocœle, penile abnormalities, cryptorchidism and imperforate anus.

The skull should be palpated and the state of the sutures noted. The circumference of the skull should be recorded together with the length and weight of the infant. Careful examination of the skull soon after birth may yield information, the importance of which is only apparent at a later time. Widening of the sutures and an increase in the circumference of the skull may be found in subdural hæmatoma or hydrocephalus, and an early diagnosis may only be possible because the state of the skull at birth has been recorded. Areas of softening or lacunæ in the parietal bones may be found, or an encephalocœle.

The baby should be handled and the limbs moved to ensure that no fracture or paralysis is present.

Examination of the heart should be carried out with care and the presence of cardiac bruits noted. The significance of any murmur may only become apparent after observation for several days.

The chest may show signs of incomplete expansion or the persistence of moist sounds from inhaled liquor. These findings are discussed on page 708.

Examination of the abdomen will usually reveal a liver edge just palpable below the costal margin, and the tip of the spleen is often palpable. In a well-relaxed infant the lower poles of the kidneys may be easily felt.

Normal Reflexes Present.—Certain reflexes are normally only present in the newborn infant. The Moro reflex is a startle or concussion reflex elicited by banging the table on which the infant is lying. The baby makes movements of abduction and adduction, the legs are drawn up, the arms are brought together in an embracing gesture and the infant cries. This reflex is usually a symmetrical response and indicates normal neuro-muscular co-ordination. Variations from this response are seen when there is a nerve palsy, a fractured clavicle or long bone, or an intracranial lesion.

If the infant is touched on the area near the mouth, he will turn his head and try to suck the object which touches him. The "sucking" or "rooting" reflex is the manifestation of the instinct to feed. A "grasp" reflex is seen when the palm of the hand or the sole of the foot is touched and is normal in the newborn infant.

Normal Progress of the Full Time Baby.—During the first week of life the baby continues to adjust himself to his extra-uterine environment.

Traumatic effects such as the caput succedaneum, petechiæ or œdema disappear rapidly and the baby begins to assume an infantile position instead of the attitude of uterine folding. The feet are less dorsiflexed and the hands less firmly clenched. The chest becomes less flattened and the head is moved freely. The cry is definite and begins to assume characteristics for hunger and pain.

Weight curve.—There is loss of weight during the first 2 or 3 days, up to 10 per cent. of the birth weight. After feeding is established the weight increases and will usually return to birth level by the 7th to 10th day. If this is not achieved it may indicate inadequate feeding, or some condition which is preventing normal progress.

Temperature curve.—At birth the infant is thermolabile and the temperature may fall below 97° F. The infant responds well to the application of external heat and within a few hours the full time infant stabilizes his temperature regulation. The rectal temperature shows a normal daily variation from 97°-99° F.

Normal Stools of the Newborn Infant.—Meconium is normally passed within the first few hours of birth, but the passage of the initial meconium may be delayed for over 12 hours. Although this is not necessarily pathological, it demands observation as it may indicate intestinal obstruction. The first meconium stool is preceded by a plug of whitish mucus.

In the next 2 or 3 days meconium is passed several times a day. Normal meconium is sticky, odourless and greenish-black in colour. After a few days "changing stools" are passed and these are non-homogeneous, thin, sour, slimy and yellowish-brown in colour. Undigested milk elements can often be seen in the stool.

Towards the end of the first week milk stools are seen. The stool of the breast-fed infant is smooth, pasty, slightly sour, acid, and mustard or golden brown in colour. The motion of the artificially fed infant is paler in colour, alkaline, pasty, and non-homogeneous.

Variation in bowel habit.—The breast-fed baby may have the bowels open only once in the day, or have any number of stools up to 5 or 6 in the 24 hours, and yet be normal. The maternal diet may influence the baby's bowel habit as many aperient substances are secreted in the milk.

Passage of urine.—The baby usually passes urine shortly after delivery, but micturition may not occur until 24 hours have elapsed. The bladder may then become palpable and the genitalia must be examined to ensure that no congenital defect exists. Pressure on the abdomen will often stimulate micturition.

The urine may at first be dark in colour, but rapidly becomes colourless and of low specific gravity.

During the first day or two the napkin may be stained pink from the deposit of urates.

Neonatal Mastitis.—The breasts of infants of either sex may swell and become engorged during the first week of life. Milk (witch's milk) may be secreted and the female may bleed from the uterus. These effects are due to maternal hormone transfer and require no treatment.

Skin.—The colour of the skin soon changes from the ruddiness seen after birth to a paler hue. The skin often becomes dry and scaly as it dries out after the long intra-uterine immersion. Fissures and cracks may appear in the folds of the ankles and wrists, but respond to an application of cold cream or lanoline. The skin is delicate and may show milia or many non-specific rashes.

It is common to observe blotchy erythematous rashes on the trunk, limbs and face. The most common rash is erythema toxicum which may become almost pustular. No treatment is required.

Sleep.—After delivery the baby usually settles to sleep and for the next week or two falls asleep after feeds, wakening only to protest with hunger, discomfort or thirst.

VARIATIONS FROM THE NORMAL

Failure to Establish Respiration (apnœa neonatorum).—Delay in the onset of respiration causes a persistence of the cyanotic hue which exists at birth. This condition is usually termed *asphyxia livida*, or blue asphyxia, and shows a typical clinical picture. The baby is cyanotic and respiratory movements are absent. Muscle tone remains good and the pulse and apex beat remain strong and not unduly rapid. Asphyxia livida is usually caused by some obstruction to the entry of air to the lungs, most commonly inhaled fluid, and the condition responds to the simple resuscitative measures of postural drainage and mucus extraction. If the response is not immediate, intranasal oxygen should be given. Should response to these measures be delayed the intubation of the trachea under direct laryngoscopy will permit suction as far as the bifurcation of the trachea and positive pressure oxygen administration by the Gibberd and Blaikley technique. This technique does not expand the lungs by positive pressure, but creates conditions of optimal oxygen tension in the bronchi and bronchioles. It has recently

been shown that absorption of oxygen may take place through the gastric mucosa into the blood-stream. A polythene double catheter is passed to the stomach, one tube carrying a supply of oxygen at a low rate of flow, and the second tube allowing the excess oxygen to empty from the stomach. While this form of treatment is of great interest, it should not be employed except in experienced hands.

The value of drugs for the stimulation of respiration is debatable, but coramine 0.5 ml., cardiazol-ephedrine 0.5 ml., or lobeline, gr. 1/20, are commonly given by intramuscular injection or directly into the umbilical vein. If the mother has been given morphine or pethidine shortly before the infant is born the infant may show the effects of these drugs. In such cases the use of nalorphine (lethidrone) intravenously will counteract the effects of these drugs on the infant's respiratory centre. It is important that injections into the umbilical cord should be made directly into the lumen of the umbilical vein. Should these solutions be injected into the umbilical artery they may cause thrombosis within the vessels which spreads in retrograde fashion to involve the internal or common iliac vessels. The end result of such a catastrophe may be gangrene and necrosis of one or both lower limbs and a fatal outcome. For this reason it is probably better to avoid injections of drugs into the umbilical cord.

Artificial respiration by mouth to mouth insufflation, or by pressure on the thoracic cage are dangerous measures. If artificial respiration is used, Eve's rocking method is the least harmful. In this technique the baby is rocked in the arms and the shift of abdominal content moves the diaphragm up and down.

In the vast majority of cases asphyxia livida responds after an interval to these resuscitative measures, but in a proportion of cases the state of the infant develops to that of asphyxia pallida.

Asphyxia pallida may follow blue asphyxia, or may be present from the moment of birth and carries a grave prognosis. It is in effect a state of shock and is very frequently due to birth trauma. In asphyxia pallida the infant is limp and toneless, with relaxed sphincters, and has a leaden grey cyanosis or pallor. The pulse is feeble and rapid, or pathologically slow and may be irregular. Respiration is often present, but the respiratory movements are irregular and shallow and show phasic variations such as Cheyne-Stokes type. The peripheral circulation is impaired and the skin may show mottling or marbled veining. Further examination may reveal a grave birth trauma. This state of asphyxia pallida is often created by intracranial hæmorrhage, intracranial damage due to prolonged anoxia, or by an almost total atelectasis. The onset of the condition may be hastened by undue manipulation and chilling during initial resuscitation.

The gravity of the state provokes the most vigorous and heroic measures at resuscitation but, if these are attempted, the end result is usually more harmful than beneficial.

The main principles of treatment should be the clearing of the respiratory tract ; the use of the head down position to promote drainage of the bronchi and the maintenance of the cerebral circulation ; maintenance of the body temperature, the provision of a high oxygen concentration in the inspired air, and rest. These conditions are best achieved in the infant incubator or oxygen tent. In cases with atelectasis the use of 5 to 7 per cent. carbon dioxide in oxygen for periods of 5 minutes may stimulate a deep respiratory rhythm.

If these principles are observed, recovery may gradually take place, or death may occur from the inevitable progression of an underlying pathological process.

Persistence of Cyanosis Despite Establishment of Respiration.

—Cyanosis may be generalized or localized to the extremities. The infant should be stimulated to cry. Cyanosis which deepens with crying suggests a congenital cardiac lesion with a right to left shunt or intracranial damage. Cyanosis which is lessened by crying and which returns with shallower respiration suggests a respiratory cause, such as atelectasis or secretion remaining in the respiratory passages.

Respiratory causes of Cyanosis

Atelectasis.—The foetal lung has the consistence of a solid tissue. The first respiration expands the alveoli of a relatively small area and total expansion is not achieved for several days. In the premature infant this process is even slower. The tissues around the lung root and the posterior part of the lower lobes are the last to expand. Atelectasis is defined as a partial or total continuation of the foetal state, but the term is used only when symptoms are present. In atelectasis the breathing is shallow and rapid with periods of apnoea and cyanosis which is variable in degree. Physical examination of the chest gives inconstant signs. The percussion note may not be impaired unless a large area of atelectasis exists. Auscultation in the newborn infant shows harsh breath sounds, often with accompanying large tube rales. The presence of fine rales indicates a pathological state and may be heard over atelectatic lung. Weak or poor air entry is sometimes found, but may be obscured by the transmission of breath sounds from adjacent lung. Radiologically the picture is of a streaking extending out from the hilum with diminished translucency of the lung field and the appearances are not those of the massive or lobar collapse seen in later childhood.

It is important to recognize and treat atelectasis at an early stage as the cyanosis and anoxia may be progressive and cause death. Incomplete expansion of lung not endangering life also provides an ideal tissue for infection and pneumonia.

The treatment consists of clearing the air passages and stimulating crying with a consequent increase in depth of inspiration. An adequate oxygen concentration should be maintained in the inspired air by the intranasal administration of oxygen or by the use of an oxygen tent. Inhalation of 5 to 7 per cent. carbon dioxide and oxygen for periods of 5 to 10 minutes promotes deep respiration. It is usually a wise measure to give intramuscular penicillin, 50,000 units 8-hourly as a prophylaxis against infection.

Aspiration.—The aspiration of mucus, liquor, or less commonly aspiration of feeds or vomit may cause cyanosis. Bubbling respiration and an inspiratory wheeze may indicate that the mishap has occurred. Aspiration and postural drainage to recover the inspired material is immediately necessary and subsequently oxygen and antibiotic therapy should be used to prevent secondary infection and pneumonia.

Hyaline membrane.—In some premature infants and less commonly in full time babies, difficulty in respiration develops a few hours after birth. The sternum and lower ribs are drawn in with each gasping breath and cyanosis and tachypnoea are evident. These signs suggest the condition of hyaline membrane disease where the alveoli are lined with a membranous exudate. This is possibly due to the organization of inhaled material or to increased oxygen tension or low humidity. The condition is commonly fatal and the lungs show patchy collapse and a membrane covering the alveolar walls. Treatment in an incubator with an oxygen level sufficient to relieve the cyanosis and the use of antibiotics is necessary. Alevaïre may be atomised into the incubator with benefit to respiration.

Nasal obstruction.—The newborn infant breathes through the nose by instinct, but has to learn mouth breathing. Nasal obstruction by secretion, œdema or congenital atresia of the nares may cause cyanosis and asphyxial attacks which are only relieved by the insertion of an airway or holding forward the tongue with the mouth open. Relief of obstruction due to infection or œdema may be given by the use of nose drops of $\frac{1}{4}$ per cent. ephedrine in saline before feeds.

Pneumothorax.—The expansion of the lung may cause patchy vesicular emphysema and rupture of a bulla produces a spontaneous pneumothorax with sudden onset of dyspnoea and cyanosis. Unless a valve pneumothorax is present the air is rapidly reabsorbed. If the cyanosis persists and deepens due to positive intrapleural pressure

from a valve pneumothorax, it will be necessary to insert a needle into the chest connected to an under-water drain bottle and permit the air to escape until the leak is sealed off.

Cardiovascular causes of Cyanosis

The cyanosis of congenital malformations of the heart is usually generalized and may be of any degree. It is often exaggerated by crying. A murmur is often, but not invariably, present. The depth and course of the cyanosis offer a rough guide to prognosis, but the murmurs may be confusing. Many newborn infants have a cardiac bruit in the early days of life, without cyanosis, and subsequently the murmur disappears. Deep cyanosis without a murmur may be indicative of cor biloculare or cor triloculare with a grave prognosis. An enlarged heart, a loud bruit and mild to moderate cyanosis may seem at first to indicate a mild cardiac lesion, but the failure of the baby to thrive and deepening cyanosis suggest complicated lesions and a poor prognosis. Murmurs without cyanosis are often of less serious consequence although septal defects, coarctation of the aorta, or a widely patent ductus may lead to cardiac failure in the early weeks of life. Murmurs may not be heard when the newborn infant is first examined and may appear later when the congenital heart lesion becomes obvious. Congenital malformations of the heart with generalized cyanosis are usually complicated lesions involving some combination of septal defects, transposition of the great vessels and pulmonary stenosis. Exact diagnosis is difficult during the neonatal period and a guarded prognosis should be given, based on the cyanosis, dyspnoea and the response of the infant to feeding and effort.

Other causes of Cyanosis

Cyanosis may be due to intracranial injuries, chilling, abdominal distension and the delayed effect of analgesics and anaesthetics used for the mother.

CHAPTER XLVIII

INFANT FEEDING

ONCE the infant has overcome the initial hazards of extra-uterine life, the problem of nutrition becomes important. The rate of growth of the infant during the first six months is greater than at any other stage in life. The normal baby doubles his birth-weight by the age of 5 months, trebles it by the end of the first year and quadruples it by the age of 2 years. To achieve this progress, the intake of food must be relatively great and of a quality which allows easy digestion and absorption.

At birth, however, the gastro-intestinal tract is scarcely ready for the task and it is sufficient during the first fortnight of life that the infant shall maintain his status. After this time the infant's need for food is great and must contain in liquid form a reasonably balanced mixture of protein, fat, carbohydrate, minerals and vitamins. This is achieved by using human or cow's milk for infant feeding.

Discussion of infant feeding is beset with difficulties largely created by the use of systems of infant feeding. No system will ever meet the needs of every infant, for each baby is an individual with his own characteristics, habits and idiosyncrasies from the moment of birth, and if the baby does not thrive on a system it is more likely that the error lies in the system than in the infant.

However, it is necessary that certain basic facts should be stated as to quantity and quality of food and these rules can do no harm so long as they are adjusted to meet the requirements of each baby. These rules are applicable to the mature baby after the age of 10 days and must be radically modified for feeding during the first 10 days of life.

Daily Fluid Requirements.—Water is necessary for the infant in amounts which are relatively greater than at any other period of life. The infant kidney is not as capable of concentrating urine as is the adult kidney and the urinary output must amount to nearly half of the total fluid intake in order to remove the waste products of metabolism. The losses of fluid from the skin, lungs and in the fæces are proportionately greater than in adult life. The infant requires approximately $2\frac{1}{2}$ ounces of fluid for every pound of body-weight during a period of 24 hours. This relatively enormous intake can best be appreciated by considering that an 11 stone man would ingest over 19 pints of fluid a day if his fluid requirements were on the same scale.

Calorie Requirement.—The diet should provide 50 calories for every pound of body-weight in each 24 hour period. This requires a calorie value of 20 calories in each ounce of the feed.

Infants below average birth weight of 7 pounds require a relatively greater fluid and calorie intake and the figures of requirements may rise to 3-3½ ounces and 60-70 calories for each pound of body-weight per 24 hours in babies weighing under 5 pounds at birth.

Protein, Fat and Carbohydrate.—Figures can be given for the amount of these substances which may be needed daily, but these are in fact supplied in a diet of breast milk or some reasonable dilution of cow's milk.

Minerals and Vitamins.—The only mineral which may be inadequately provided by a milk diet is iron, an element which is always jealously conserved in nature. At birth the baby has only small reserves of iron in the liver. During the period of intensely rapid growth in early infancy, there is a corresponding increase in the total number of red blood cells in the body. The reserve stores of iron in the body are soon exhausted in forming hæmoglobin for the extra red blood-corpuscles which are produced, and, unless adequate supplies of iron are available in the diet, the infant develops the hypochromic anæmia of infancy. Neither cow's milk nor human milk contain sufficient iron for this purpose and it is usually desirable to supplement the diet with additional iron after the second month of life, or earlier in the premature infant. Mist. ferrous sulph. (N.F.) may be given in doses of ½-1 drachm or neoferrum or colliron minims 5-10 twice a day.

Vitamins.—The vitamin content of breast milk is probably adequate for the needs of the baby, but cow's milk which has been heated and dried milk powders do not contain sufficient. It is generally agreed that the optimal daily intake of vitamin C is 50 mg. of ascorbic acid. The recommended intake of vitamin D to prevent rickets is 800 i.u. daily from all sources, and any natural source of vitamin D yielding this figure will also provide an adequate intake of vitamin A. Milk usually provides a satisfactory vitamin B dosage.

Additional vitamin D and C should be given to babies who are artificially fed and it is probably desirable to do the same for breast fed babies. Vitamins A and D may be given as National Vitaminized Oil. The oil may be given from the age of one month and the dosage gradually increased from a few drops until the full dosage of one drachm daily is reached. Fish liver oil concentrates such as adexolin minims 10, radiostoleum minims 10, or halibut liver oil minims 6 may be given instead of cod liver oil.

Vitamin C is usually given as orange juice diluted with water, sweetened with a little sugar, and given as an extra drink. The juice of half an orange may be given, or one drachm of the concentrated orange juice issued by the Ministry of Food. If the infant cannot tolerate orange juice, which sometimes causes colic, it may be replaced by rose hip syrup, black currant puree or tomato juice, or ascorbic acid may be added to the feeds.

BREAST OR BOTTLE FEEDING

It is desirable that the baby should be breast fed whenever this is practicable and that cow's milk should be used only when the mother cannot or does not wish to feed her own baby, or when her health renders breast feeding inadvisable. The proportion of babies who are successfully breast fed varies with nationality, social and economic circumstances, and according to the personal opinions of those who deliver and care for the infants. The dried milk preparations are widely advertised, but there is little publicity for the advantages of breast feeding.

Many expectant mothers will ask whether breast feeding will give their infants additional benefits compared with bottle feeding, and for what reasons. The following points may be advanced for and against this belief:—

1. Breast feeding is nature's way. Cow's milk differs from human milk in its composition and each carries amino-acids, fats and minerals most necessary to the species from which it is derived and the most suitable for the young of the same species.

2. Breast feeding is easier and cleaner, and in commercial terms is "direct from producer to consumer without the intervention of the middle-man". Breast milk is virtually sterile and is given to the baby directly and at body temperature, while the preparation of an artificial feed involves many processes from the milking of the cow to the final feed in its bottle, and each step offers an opportunity for contamination and infection which does not occur in breast feeding.

3. Breast feeding is more convenient. While it is true that breast feeding takes less time than the preparation and giving of the bottle, the latter may be given by some person other than the mother. Mothers who are forced by economic necessity to work for part or all of the day may not be able to breast feed their babies.

4. Breast feeding is cheaper. This argument does not carry very much weight as dried milk is now available in Britain to all mothers at a reduced cost under Government subsidy.

5. Breast feeding affords psychological fulfilment to the mother. Psychologists have laid great stress on the part which breast feeding plays in the psychological development of the infant and the fulfilment of maternal instinct. Even if these arguments cannot be accepted in their entirety, there is a great volume of opinion based on personal experience among parous women to support this belief.

6. Breast feeding creates a healthier baby. The breast fed baby never suffers from scurvy and rarely from rickets. Breast fed babies suffer fewer and less severe infections than bottle fed babies especially when respiratory and gastro-intestinal illnesses are considered. Breast milk is more easily and completely digested than is cow's milk and is of greater help in the treatment of a sick baby. Sore buttocks occur less frequently in the breast fed infant than in the bottle fed.

ANATOMY AND PHYSIOLOGY OF LACTATION

The human breast is a multilobular gland composed of approximately twenty segments arranged radially from the nipple, the secretory or glandular tissue being mainly peripheral. The branch-like duct system from each segment converges to form a single duct which opens on the nipple. Immediately before opening on the nipple, each duct has a dilatation called the lactiferous sinus. This sinus lies immediately beneath the areola of the nipple and is a thin walled portion of the duct which is capable of distension by milk to a calibre of 0.5-1.0 cm. The alveoli are surrounded by a myo-epithelial contractile network which also invests the ducts. The active elements of the breast are supported by a connective tissue stroma and a variable amount of fat. The whole breast is lavishly supplied with blood.

Changes in the Breast with Maturation.—Before puberty there is little difference between the breasts in the two sexes, and they consist of a flattened nipple, a rudimentary duct system and little glandular tissue.

As puberty approaches, the female breast shows development of the feminine contour due to nipple prominence and deposition of fat. With successive menstrual cycles ovarian oestrogens promote a development of the duct system, but hyperplasia of the secreting tissue does not occur until the time of pregnancy under the influence of placental oestrogens and progesterone. During pregnancy there is a considerable increase in the duct system, but the enlargement which is seen in the breasts is mainly due to the hyperplasia of the glandular tissue from the 3rd month onwards. This may be due to an effect of the oestrogens on the pituitary or to a sensitization of the breast by pituitary secretion,

permitting a response to the effect of the placental oestrogens and progesterone present in the blood. From the end of the 24th week onwards the breast is capable of secreting milk and during the last trimester colostrum can be expressed from the breast, although active lactation is held dormant.

Physiology of Lactation.—The factors which govern lactation are not fully known and it is convenient to discuss the processes of secretion, or formation of milk, and excretion, or the yielding of milk, separately.

The **secretion** of milk is the transformation of amino-acids, minerals, glucose and lipoids present in the blood-plasma into the caseinogen, lactalbumin, milk fats and lactose found in the alveoli and ducts. This process takes place by the activity of the epithelium of the alveoli. Only a portion of the milk yielded at a feed is preformed and the major portion is actually secreted during the time of feeding. There is evidence to support the belief that prolactin is mainly responsible for the secretion of the alveoli. This pituitary secretion is influenced by the level of the blood-oestrogens. When blood-oestrogens are low, as in the non-pregnant woman, the pituitary does not secrete prolactin. In the puerperium the blood-oestrogens are at a level which stimulates prolactin production and lactation, but if the level is further raised prolactin production and lactation may be inhibited. This is used clinically when stilboestrol is given to inhibit lactation. It is possible that the pituitary may secrete other substances which promote lactation, but this is speculative.

Other hormones may play a part in the production of milk. Thyroid and adrenal hormones are probably involved, but the evidence is inconclusive.

During the later months of pregnancy the breast is ready to lactate, but milk is not secreted. After delivery of the infant, colostrum is secreted for 24 to 48 hours and then the breasts become congested and the milk is secreted. The suspension of lactation until after the birth of the child and the expulsion of the placenta is attributed to an inhibitory substance secreted by the placenta. With the expulsion of the placenta this substance is no longer produced and once it has all been excreted from the blood-stream milk is produced.

The Excretion or Yielding of Milk.—The term sucking is often used to describe the process by which the baby gains milk. Sucking is in fact a relatively unimportant part of the complex process which is involved and the term suggests that the process is wholly dependent on an activity of the baby.

When lactation is well established, observation of a baby at the breast shows that the process is a complicated one. The infant draws the nipple into the mouth and champs on the areola with the gums. The lips form a seal on the nipple and areola and there is suction in the mouth and swallowing of the milk obtained. If the sucking infant is removed from the breast, milk continues to run or spurt from the breast, indicating an active excretion by the breast as well as active sucking by the infant.

Part played by the infant.—When the baby takes the breast the nipple is drawn into the arch of the hard palate and held there by the tongue to be exposed to suction which clears the milk to the back of the mouth to be swallowed. The lips form a seal on the breast and the gums champ on the areola. This champing action falls on the dilated lactiferous sinuses of the duct and cause a milking effect which propels the contents into the infant's mouth.

Active excretion by the breast.—The active excretion which can be demonstrated is probably due to the contractile myo-epithelial network which invests the alveoli and ducts, and implies an active process in the breast. Veterinary studies have shown that stimulation of nerve endings in the nipple initiates impulses which are conveyed to the posterior lobe of the pituitary gland by a reflex arc and provoke a release of pitocin to the blood-stream. The pitocin acts on the myo-epithelial structures of the duct system and causes propulsion of the milk along the ducts. This has been termed the let-down reflex. The reflex arc can be interrupted or inhibited psychologically with a failure of excretion of milk. These observed facts have been confirmed in the human, and the let-down reflex is known to parous women as "the draught" or a prickly sensation in the breast after the baby has begun to feed, coinciding with the onset of the flow of the milk.

Relation between Physiological Observation and Clinical Applications.—In satisfactory breast feeding it is evident that the glandular tissue of the breast must be adequately developed and a hormonal secretion sufficient to stimulate the breast to lactate must also be present.

The infant must be able to take the nipple into the mouth and exert suction, and to oppose the gums in order to milk the lactiferous sinus. Even when these two requirements are satisfied, satisfactory lactation is dependent upon the establishment of the let-down reflex and this may be inhibited by a psychological upset in the mother or by painful stimuli provoked by the baby.

Failure of lactation can be explained on these grounds in almost every case.

Composition of Colostrum and Breast Milk

For the first 2 days colostrum is secreted by the breast and on the 2nd, 3rd and 4th days the secretion changes to normal breast milk. Colostrum is a yellow fluid containing large fat globules, the colostrum corpuscles, and has a high mineral, low sugar and moderate protein content. It has been claimed that colostrum is important to the infant because of a high content of antibodies but, while this is true of other mammalian species, it is probably not important in the human. Colostrum is said to possess laxative qualities and aids the evacuation of meconium. No laxative constituent has ever been demonstrated.

When the secretion changes from colostrum to milk, the colour changes from yellow to a bluish-white. With successful lactation the amount of milk which is given increases daily and by the 5th day should reach a total of 10 ounces, and by the 10th day over 16 ounces should be obtained.

COMPOSITION OF BREAST MILK

	<i>Protein</i> <i>per cent.</i>	<i>Fat</i> <i>per cent.</i>	<i>Carbohydrate</i> <i>per cent.</i>
Colostrum	2.25	3.15	4.00
Milk	1.25	3.50	7.25

Breast milk protein contains three fractions: caseinogen, lactalbumin and lactoglobulin. The latter is present only in small amounts and the proportion of lactalbumin to caseinogen is 2 to 1. The calorie value of breast milk is 20 calories per ounce.

Management of Feeding in the Newborn.—The essence of the introduction of breast feeding in the newborn infant is a gradual increase in the time at the breast and the amount which the infant is allowed to take or can obtain. The objects of this gradual approach are to stimulate lactation; to encourage the baby to suck without allowing him to become discouraged by failure to obtain milk; and to accustom the nipples to the mild trauma of sucking.

The following points should be considered:—

Interval after Birth when Feeding is First Allowed.—Although the baby should be handled by the mother as soon after birth as possible, it is probably best to allow the first feeding 6 to 8 hours after delivery. Both mother and baby deserve this period of rest and recovery. If the infant is ill, or has suffered from a difficult delivery, the baby may be kept from the breast and resting until 24 to 48 hours have elapsed.

Frequency of Feeding.—With babies of average birth weight it is usually convenient to permit three feedings on the 1st day and thereafter five feeds at intervals of 4 hours.

Small babies with a birth weight of 6 pounds or less are usually better with more frequent feeds. A 3-hour interval between feeds and a total of six or seven feeds in the 24 hours proves more satisfactory. Some normal-weight babies who tire easily at feeds or who are especially hungry because of delayed lactation, may do better on a 3-hourly schedule. Large babies of 9 pounds and over are often difficult to satisfy in the early days of lactation and are more contented when fed six or seven times in the 24 hours.

The regimen must be varied to suit the individual baby and an elasticity of technique must be maintained. In general, a 4-hourly schedule will be satisfactory for the great majority of newborn infants.

Time at the Breast.—From the 1st to the 7th day of feeding it is wise to increase the time permitted at the breast with each successive day. On the 1st day 1 or 2 minutes at each breast is usually sufficient and this is gradually increased to 10 minutes by the 7th day.

Alternation of Breasts.—Each feed should be started on the breast which was taken last at the previous feed. During a feed from one breast lasting 10 minutes the infant will obtain two-thirds of the milk in the first 5 minutes. During the second 5 minutes the yield is much less, but is of a higher fat content as the breast is emptied. When put to the second breast, only part of the milk may be taken and the breast left with a residue of rich milk. At the next feed this breast should be offered first to ensure that this milk is taken and the breast emptied, as this promotes good lactation. If the breast is continually left with a residue of milk, lactation may be diminished and may eventually fail.

One Breast or Two Breasts at a Feed.—In the young infant it is usually necessary to offer both breasts at each feed time to supply the amount of milk required. Once lactation is thoroughly established, some women can supply the babies' needs from one breast only at each feed.

Amount taken from the Breast.—Experience has shown that the baby will feed at each breast for 7 to 10 minutes once lactation has become well established. This is an arbitrary time and in fact the baby will feed until his needs are satisfied or until the breasts are emptied. This may be achieved by the end of 7 to 10 minutes at each breast in the average case, but the time required may be as little as 4 minutes, or it may take as long as 15 minutes at each breast. The infant is usually the best judge on this point and confirmation may be found in an adequate gain in weight.

Extra Fluids.—Under civilized conditions the baby is warmly wrapped up and is kept in a warm environment. The infant may not obtain from the breast an adequate fluid intake during the first few days and will show mild dehydration and irritability. The infant should be offered fluid by spoon during these days. Boiled water or fifth normal saline are the ideal fluids, and are offered after each feed in sufficient amount to satisfy thirst.

Position and Management of Breast Feeding.—The infant is usually nursed by the mother propped up in bed or sitting in a low-armed chair. The infant is held in the crook of the arm on the same side as the breast which is to be given, with the weight of the baby supported on the forearm. The head should be allowed to extend beyond the bend of the elbow as most infants feed better with the neck extended rather than flexed. Whether the infant lies flat or is kept upright is usually best determined by trial as this varies from one baby to the next.

With the baby in this position the mother should bend forward slightly and allow the nipple to fall to the baby's mouth. When the breast is large or fat the redundant tissue can be restrained with the fingers of the other hand and the nipple allowed to protrude between the extended fingers.

If the mother is ill, the infant may be laid on the bed alongside her between the trunk and the arm. By turning on her side the mother can bring the nipple to the baby's mouth.

Reluctance to Feed.—This will often indicate that the infant is ill. A healthy baby will sometimes refuse to take one breast, but will feed if the other breast is offered first. In other cases the infant refuses to "get on" the breast, but may be encouraged if a few drops of milk are expressed and allowed to fall on the baby's lips.

Deficient Lactation.—Adequate lactation has been defined as a secretion of 10 ounces by the 5th day and 16 ounces by the 10th day. If these amounts are not achieved, the baby of normal birth weight will not be adequately fed.

Failure of Lactation.—This may be due to an inadequate development of gland tissue, although this bears no relation to the size of the breasts. Some women with small breasts with little fat, produce large quantities of milk, while the large fat breast may contain little secreting tissue. There is no therapy which will promote lactation under these conditions.

Delayed Lactation.—A proportion of women are slow to lactate, but if the food, and especially fluid, intake is adequate, lactation is eventually established. Small doses of thyroid, gr. $\frac{1}{2}$ daily, or Lugol's iodine, minims vi, twice a day are sometimes helpful. Prolactin by injection has been disappointing, while milky drinks such as lactagol are probably only effective by their psychological effect.

The best stimulus to delayed lactation is emptying the breasts and this is achieved more effectively by the infant than by manual expression.

Self Demand Feeding.—In self demand feeding it is the practice to feed the infant whenever he cries and the cry cannot be attributed to colic, wind or other cause of physical discomfort. The demands for feeds may be as frequent as 12 or 14 times in the day at the start, but as the infant grows older are reduced in number until the rhythm approximates closely to a 3 or 4 hour schedule. It is argued that this system makes for a happy and contented baby and avoids possible psychological upsets which may give rise to symptoms in later infancy and childhood. This technique requires that the baby be kept in a cot by the side of the mother's bed so that he may be lifted and fed at the times when he demands this attention. This is easy to achieve in a private house and in some institutions, but may not be possible in maternity wards of large size because of the distraction to the other mothers.

DIFFICULTIES IN BREAST FEEDING

These difficulties may arise from causes in the infant or from causes in the breasts.

Causes in the Infant.—If the baby is suffering from an infection, cerebral trauma or some congenital heart lesion, he may be too weak to take the breast or may tire before a sufficient amount of milk is taken. In such cases it is necessary to feed the infant with a spoon or by tube until the breast can be taken satisfactorily.

When the baby is very small there may be disproportion between the size of the nipple and the baby's mouth, but this will be remedied as the baby grows. Congenital defects such as hare lip and cleft palate will create mechanical difficulties in feeding and similar difficulties will arise when there is obstruction to nose breathing. This is occasionally caused by the occlusion of the anterior nares by the infant's upper lip when the nipple is taken into his mouth.

Over-distension of the stomach with air will cause the infant discomfort and he may refuse to take the breast. This excessive

swallowing of air may arise from difficulty in taking the nipple and it may be necessary to de-wind the baby several times during the feed.

Air swallowing.—During a feed the infant must alternate in some rhythm between swallowing and breathing. The ability of different babies to achieve this varies very greatly and the inhalation of milk during respiration causes choking and the expulsion of milk from the air passages by coughing. Most babies, however, swallow air with the milk.

If a considerable volume of air is swallowed this may inconvenience the baby in one of several ways. The air may pass from the stomach to the intestines and cause colic between the feed times. If the swallowed air remains in the stomach and the pylorus remains closed, the stomach becomes distended to capacity before an adequate amount of milk is taken and the infant refuses to feed any longer. When the infant is replaced in his cot the air may be expelled from the stomach and carry milk with it as vomit.

Although it must be admitted that some infants do not appear to suffer discomfort from considerable gastric and intestinal distension with air, the majority are inconvenienced by this. It is, therefore, desirable to bring up the wind one or more times during a feed. To do this without spilling out the milk as well requires a certain degree of practice and dexterity on the part of both the mother and the infant. The infant is sat upright to bring the air bubble up to the fundus of the stomach. The mother places one hand across the upper abdomen and lower ribs of the infant with the baby leaning forward against this hand. With her free hand the mother rubs or pats the back of the baby quite firmly. After an interval the baby will bring up wind with a loud noise. This may have to be repeated several times before the stomach is empty of wind. Alternatively, the baby may be held face downwards against mother's shoulder, and the back rubbed and patted. Some babies bring up the wind most satisfactorily when lying face downwards across the mother's knee. The wind should be brought up at least once during the feed and always at the finish of the feed.

Causes in the Mother.—*Anatomical.*—When the nipples are poorly developed or retracted, the infant cannot draw the nipple into the correct position in the mouth for satisfactory feeding. This should be detected during antenatal examination and corrected by the wearing of nipple shields. In cases in which treatment has not been given before delivery, the condition may improve rapidly under the stimulus of the infant's attempts to feed or may be overcome by feeding through nipple shields, although this is seldom found to be

successful. Inadequate development of the nipple may prove an insuperable barrier to satisfactory feeding in some cases.

Congestion.—On the 3rd or 4th day of the puerperium, the effect of the placental inhibitory substance diminishes and the breasts come under the influence of prolactin with a great increase in vascularity and secretion of milk. The breasts become congested and are hard, knotty and painful. The congestion may be so severe that milk cannot be taken and the breasts are so acutely painful that the mother is not able to tolerate the infant at the breast. This state of congestion develops very rapidly and a close watch must be maintained. Before congestion is fully established, the acute stage may be prevented by manual expression of milk or by the use of a breast pump. Manual expression of the congested breast may be so painful that the woman is unable to tolerate the discomfort, and, even if the pain can be borne, the skin of the breast may be bruised by unskilled expression. Some midwives become very expert at expression of the breasts by hand and are able to teach the mother to do this for themselves. In some centres the pregnant woman is taught to express the breasts daily during the last few weeks of pregnancy and it is claimed that this reduces the frequency and severity of congestion of the breast during the first few days of the puerperium.

If manual expression is not possible the use of a breast pump may help to relieve the congestion. The old fashioned rubber and glass suction pump is seldom effective and may cause great discomfort to the woman or traumatize the nipple. The electric breast pump, with the rhythmic gentle negative pressure created in the soft rubber breast cup, is often more successful. When œdema of the nipple is present, it is usually advisable to avoid the use of breast pumps.

In other cases the administration of stilbœstrol damps down the secretion of milk and prevents the full development of congestion. Oral administration of 5 mg. of stilbœstrol may be repeated at 4-hourly intervals for 3 doses. The breasts should be well supported with wool and bandage.

Cracked nipple.—The skin of the nipple may become traumatized and fissured in the early days of feeding. This is more common in the fair-skinned mother. The crack or fissure may only be visible with the aid of a lens, but causes severe pain when the infant feeds. The infant should not be allowed to feed on the breast for 24 hours or more and the breast emptied by expression. When feeding is started again, the time for each feed should at first be short and increased gradually if the crack remains healed. Many local applications are used such as lanoline, liquid paraffin, anæsthetic ointments, tinct. benzoin co. or antibiotics, but none is specific. (See Chapter XLIV, page 623.)

Breast abscess.—Infection of the breast and abscess formation sometimes follow gross engorgement or cracked nipples, but may appear without obvious cause. The infection is usually staphylococcal and may progress to abscess formation. The breast becomes tender, hot and swollen and the mother has pyrexia and toxic signs.

The baby cannot be fed from the affected breast during the acute stage because of the pain caused to the mother, but the breast must be kept emptied as damming back of milk tends to promote spread of infection. Early recognition of infection may permit cure by anti-biotic therapy or incision and drainage of the abscess may be necessary. The surgical treatment of breast abscess is discussed in Chapter XLIV.

Once the acute stage is over, there is no necessity to keep the baby off the breast or to wean the baby unless the abscess involves the nipple or nearby tissues.

Contra-indications to Breast Feeding.—The principal contra-indications are severe heart or kidney disease in the mother, or puerperal mania. Pulmonary tuberculosis which has recently been active is usually a complete bar to breast feeding by reason of the added strain to the mother and the risk of reactivating the disease. The risk to the infant is not inconsiderable if the mother has active pulmonary tuberculosis and this risk is present in the same degree whether the mother feeds the baby at the breast or gives him feeds by bottle.

Preparation for Lactation.—The best preparation for lactation is to ensure that the expectant mother is aware of the normal course of events following delivery and is mentally prepared for breast feeding.

Attention must be given during antenatal examination to the state of the nipples. A poorly developed, retracted or inverted nipple cannot be drawn into the infant's mouth and may suffer trauma because the baby cannot get on to the nipple properly. The nipples should be examined to see whether they are retracted or inverted and to ascertain whether the nipple can be protracted. The external appearance of the nipple is not a certain guide and the base of the nipple should be gently pinched to make it protrude. When the nipples are retracted the mother should be encouraged to wear glass nipple shields during the day and at night during the later part of pregnancy as this will, in the majority of cases, correct the abnormality.

There should be no attempt to harden the nipples with spirit; only the ordinary hygienic measures are necessary. Dry skin on the nipples may be treated with an occasional application of lanoline. Expression of the breasts during the last few weeks of pregnancy has been advocated as a way in which congestion may be prevented, but this requires

special instruction to the mothers, not all of whom find the technique easy to learn.

No special dietetic régime need be advised so long as the expectant mother is taking a normal balanced diet with an adequate protein, calcium, iron and vitamin intake.

Excretion of Drugs in Breast Milk.—Many drugs which are taken by the mother are excreted in the breast milk and in some cases the concentration may be sufficient to affect the infant. This may occur when heavy doses of the barbiturates are exhibited to the lactating woman and the infant may be affected by the amounts secreted in the milk. The possibility must always be kept in mind. Purgatives taken by the mother may affect the infant and an excess of citrous fruits or large stoned fruits may have a similar effect. Nicotine may be secreted in the milk but does not appear to affect the baby; smoking, however, seems to reduce the milk output and nursing mothers should smoke only in moderation.

ARTIFICIAL FEEDING

When breast milk is not available, the infant is usually fed on cow's milk. In rare cases of intolerance to cow's milk other mammalian milks may be used; asses', mares' or goats' milk have been employed. When an infant shows an allergy to cow's milk protein, various dried milks may be given from which the protein has been in part removed, or a vegetable milk made from soya bean can be used. Milk allergy is uncommon and causes colic and frequent, loose, undigested stools. In general, liquid, dried or evaporated cow's milk, modified by dilution with water and the addition of sugar, is the basis of artificial feeding. Further modifications by peptonization or by the addition of citrates is occasionally used in cases of digestive upset.

It is claimed that humanized cow's milk mixtures should be used for infant feeding, but it is not possible to change cow's milk into human milk and the term should not be used. So long as it is realized that the cow's milk cannot be humanized, but can very readily be adapted to the needs of the human infant, then artificial feeding need present few difficulties.

COMPARISON OF THE COMPOSITION OF HUMAN AND COW'S MILK

	<i>Protein per cent.</i>	<i>Proportion of Caseinogen to lactalbumin</i>	<i>Fat per cent.</i>	<i>Carbohydrate per cent.</i>
Human	1.25	1 to 2	3.5	7.25
Cow's milk	3.5	4 to 1	3.5	4.75

Calorie value of 1 ounce of milk = 20 calories.

In both milks the carbohydrate is lactose and the difference lies only in the quantity present. The percentage of fat is approximately the same in both milks, but the emulsion of fat in cow's milk is much coarser. Human milk has a bluish, watery appearance and fat does not readily separate to the surface. In cow's milk the coarser emulsion of fat gives a yellow appearance and the fat globules separate as cream, and this coarse fat emulsion presents one of the problems to using cow's milk to feed the young infant because of difficulty in digestion.

The total protein in cow's milk is twice as great as in breast milk and, although the lactalbumin content is the same, cow's milk contains eight times the caseinogen of breast milk. Lactalbumin is a soluble, heat coagulable protein and is easily digested. The skin which forms on boiled milk is lactalbumin. Caseinogen is converted to casein by the action of gastric juice and cow's milk curds are coarser than those produced in breast milk. The junket produced by the action of rennet on milk is casein. This high protein content presents the second digestive difficulty in the use of cow's milk in infant feeding.

These difficulties are reduced by diluting cow's milk with water for feeding young infants, but this also reduces the calorie value and concentration of sugar. The addition of extra sugar compensates for both these deficiencies.

General Principles for Artificial Feeding.—After the 7th day of life, the infant requires $2\frac{1}{2}$ ounces of fluid for each pound of body-weight per diem. Each fluid ounce of feed should have a value of approximately 20 calories. During the first week of life these figures are reduced, and the size and strength of feeds is gradually increased as the digestive capacity of the infant is established.

Feeding with Liquid Cow's Milk

Cow's milk is a potentially dangerous liquid and may suffer bacterial contamination from the cow, the milker, or from the handling of the milk before it reaches the consumer. The inspection and tuberculin testing of herds, the use of mechanical milking techniques and the pasteurization and hygienic bottling of milk have greatly reduced the hazard of infection with tubercle bacilli, streptococci, *E. coli*, diphtheria bacilli, *B. typhosus*, etc., but milk should always be brought to the boil before being used in infant feeding, no matter what grade of milk is employed.

Strength of Feeds.—Opinions differ widely on the dilution of milk which should be used for infant feeding.

Constant Dilution.—One school of opinion states that the same dilution of milk should be used, whatever the age or weight of the baby. Thus, $1\frac{3}{4}$ ounces of cow's milk plus $\frac{3}{4}$ ounce of water is given in each period of 24 hours for each pound of body-weight plus 1 teaspoonful of sugar per pound up to a maximum of 10 teaspoons in the day.

EXAMPLE.—A 10 lb. baby is given :—

Cow's milk	.	.	.	.	.	$10 \times 1\frac{3}{4}$ oz.	=	$17\frac{1}{2}$ oz.
Water	.	.	.	.	.	$10 \times \frac{3}{4}$ oz.	=	$7\frac{1}{2}$ oz.
Sugar	.	.	.	.	.	10×1 tsp.	=	10 tsp.

This quantity of feed is divided into 5 equal portions and the feed given every 4 hours.

Varying Dilution.—It is more usual to give the young infant a dilute feed and to increase the concentration of cow's milk as the age and weight of the baby increases. This method gives the immature digestion a weak mixture to deal with and the strength of cow's milk in the mixture is increased as the digestive powers increase.

The usual dilutions which are employed are related to the age of the infant.

	<i>Cow's milk</i>	<i>Water</i>
2-4 weeks	1 part	1 part plus sugar
1-3 months	2 parts	1 part plus sugar
3-6 months	3 parts	1 part plus sugar
Over 6 months	Whole cow's milk	1 part plus sugar

EXAMPLES :

9 lb. baby—5 weeks of age

Total per day, $9 \times 2\frac{1}{2}$ oz. = $22\frac{1}{2}$ oz.

Two to one mixture

Cow's milk	.	.	.	.	15 oz.
Water	.	.	.	.	$7\frac{1}{2}$ oz.
Sugar	.	.	.	.	9 tsp.

12 lb. baby— $3\frac{1}{2}$ months of age

Total per day, $12 \times 2\frac{1}{2}$ = 30 oz.

Three to one mixture

Cow's milk	.	.	.	.	$22\frac{1}{2}$ oz.
Water	.	.	.	.	$7\frac{1}{2}$ oz.
Sugar	.	.	.	.	10 tsp.

Simplified System.—Experience has shown that a rule of thumb method may be evolved from the above principles. Briefly, and without detailing the reasons, the calculation of the correct feed may be made in the following way for infants on a 4-hourly schedule.

Divide the weight of the baby in pounds by two and this gives the size of each feed in ounces: $1\frac{1}{2}$ ounces of the feed should be of water and the remainder of cow's milk with the addition of $1\frac{1}{2}$ teaspoonfuls of sugar.

EXAMPLES :

Weight of baby .	7 lb.	9 lb.	12 lb.	15 lb.
Size of feed .	3½ oz.	4½ oz.	6 oz.	7½ oz.
Feed made of :				
Water .	1½ oz.	1½ oz.	1½ oz.	1½ oz.
Cow's milk .	2 oz.	3 oz.	4½ oz.	6 oz.
Added sugar .	1-1½ tsp.	1-1½ tsp.	1-1½ tsp.	1-1½ tsp.

The use of Dried Milks

A great variety of different dried milks is available commercially for infant feeding, but the majority of these milks fall into one of three categories:—full cream dried milk, half-cream dried milk and humanized dried milk. In many cases the addition of extra vitamins or iron, or the modification of the protein in the milk is claimed to afford the product special advantages for the feeding of infants, but the milk remains of the same fundamental type.

Full Cream Dried Milks.—These represent the powder which results from the evaporation of cow's milk to dryness. When one level scoop or measure of the powder is reconstituted to 1 ounce with water the resulting fluid is equivalent to 1 ounce of cow's milk. The scoop of the dried powder has a calorie value of 20 calories.

The process of drying has an effect on the protein of the milk and causes some degree of breakdown of the proteins to simple compounds. The heating also destroys the vitamins to some extent; vitamin C is most affected with vitamins A and D being reduced to a lesser degree.

Half-cream Dried Milk powders.—These dried powders are prepared by the partial skimming of liquid milk before drying and sugar is then added to raise the calorie value of the powder. Half-cream National Dried Milk differs from the usual commercial half-cream milk in that there is no added sugar in the dried powder and affords the extra advantage that sugar can be added to the reconstituted feed to suit the needs of the individual baby. The calorie value of one scoop of the half-cream dried milks is usually 16-18 calories.

Humanized Dried Milk Powders.—Humanized dried milks are usually prepared by the removal of some protein and the addition of a considerable amount of sugar.

Use of Dried Milks.—The humanized and half-cream dried milks should only be used in the early weeks of life and should not be employed after the infant has reached 10 pounds in weight or 3 months of age.

These milks are usually given as one scoop for each ounce of feed which is required, and, except for half-cream National Dried Milk, require no added sugar.

Full-cream Dried Milk.—The number of ounces of feed which should be given every 4 hours is determined by dividing by two the weight of the infant in pounds. If $1\frac{1}{2}$ is subtracted from this figure, the number of scoops of dried milk required at each feed is found. This quantity of dried milk powder is reconstituted with water to make the full amount of feed required and sugar added as $\frac{1}{2}$ -2 teaspoonfuls per feed according to the need of the infant.

EXAMPLES :

Weight of baby . . .	10 lb.	12 lb.	15 lb.
Size of feeds 4-hourly . .	5 oz.— $1\frac{1}{2}$	6 oz.— $1\frac{1}{2}$	$7\frac{1}{2}$ oz.— $1\frac{1}{2}$
No. of scoops of F.C. Milk .	$3\frac{1}{2}$ scoops	5 scoops	6 scoops
No. of ounces of water . .	5 oz.	6 oz.	$7\frac{1}{2}$ oz.
Added sugar	$\frac{1}{2}$ -2 tsp.	$\frac{1}{2}$ -2 tsp.	$\frac{1}{2}$ -2 tsp.

Evaporated or Condensed Milks.—These milks enjoy a greater popularity in North America than in this country. Sweetened and unsweetened varieties are obtainable. Sweetened milks should never be used for feeding the normal infant. The unsweetened milks are merely cow's milk which has been evaporated to two-fifths of the original bulk and dilution of 1 ounce of the evaporated milk with $1\frac{1}{2}$ ounces of water yields $2\frac{1}{2}$ ounces of cow's milk. Further dilution is necessary for infant feeding. Half cream evaporated milk is now available and provides a useful form of milk for infant feeding.

Addition of Sugar to the Feed.—Lactose, or milk sugar, exists in nature only in mammalian milk and is therefore expensive to use for sweetening artificial feeds. Glucose is also relatively expensive and may sometimes cause fermentation in the gut with loose stools and sore buttocks. Sucrose (cane sugar or table sugar) is a disaccharide which is split on digestion to glucose and fructose and is well-suited for sweetening artificial feeds. The amount which is necessary at each feed varies from $\frac{1}{2}$ to 2 teaspoonfuls and should be varied according to the calories required and the bowel habit of the infant. Too little sugar may cause a costive bowel habit and an excess may cause relaxed stools. The correct amount is usually determined by trial.

When an otherwise apparently correct feed with adequate sugar still leaves the infant constipated, use of brown or demerara sugar may be helpful. With relaxed stools dextri-maltose may be given. The caloric value of a level teaspoonful of sugar is about 20 calories.

ARTIFICIAL FEEDING DURING THE FIRST TEN DAYS OF LIFE

The baby may be fed with liquid milk or any variety of dried or evaporated milk so long as the mixture is given in sufficiently dilute form. It is usual, however, to give half-cream dried or evaporated milk or humanized dried milk. The first feeds must be small and dilute and the increases in size and strength made very gradually until full feeds are given by the 8th day.

Although there are many methods which may be employed, it is proposed to discuss only the simplest method. The figures given are based upon an average baby of 7 pounds birth-weight fed at intervals of 4 hours. With smaller or larger babies the amounts must be adjusted accordingly.

Quantities.—The baby is offered $\frac{1}{2}$ ounce of boiled water every 3 or 4 hours during the first 24 hours of life. On the 2nd day $\frac{1}{2}$ ounce of the milk mixture as detailed later is given 4-hourly and the amount increased by $\frac{1}{2}$ ounce each day until the baby is offered $3\frac{1}{2}$ ounces at each feed on the 8th day of life. These quantities must be adjusted in a common sense way; in some instances the baby may refuse to take all the feed and should not be pressed; in other cases the baby may appear to be hungry and should be offered a little extra.

Strength of Feeds.—By the time the baby is 8 days old the feed can be calculated according to the weight of the infant. This may be briefly summarized as follows:—

1. Liquid milk : $1\frac{1}{2}$ ounces of cow's milk, water $1\frac{1}{2}$ ounces, sugar $1\frac{1}{2}$ teaspoonfuls.
2. Dried milk.
 Full cream : $1\frac{1}{2}$ scoops, water 3 ounces, sugar $1\frac{1}{2}$ teaspoonfuls.
 Half-cream National Dried Milk : 3 measures, water 4 ounces, sugar $1\frac{1}{2}$ teaspoonfuls.
 Half-cream : 1 measure to 1 ounce.
 Humanized : 1 measure to 1 ounce.
3. Evaporated milk : 1 ounce milk, water 3 ounces, sugar $1\frac{1}{2}$ teaspoonfuls.
4. Half-cream Evaporated Milk : 1 ounce milk, water 1 ounce, sugar $\frac{1}{2}$ teaspoonful.

When artificial feeding is introduced on the 2nd day of life, any of these standard mixtures may be given in $\frac{1}{4}$ strength, *i.e.* 1 part of the mixture diluted with 3 parts of water. On the 4th day the mixture is given in $\frac{1}{2}$ strength, *i.e.* 1 part of the mixture to 1 part of water. By the 6th day $\frac{3}{4}$ strength may be used, *i.e.* 3 parts of the standard mixture to 1 part of water. On the 8th day and subsequent days the mixture may be given in full strength and increased as the baby's weight rises.

These feeds must always be varied in accordance with the individual baby's needs and idiosyncrasies. Smaller babies should have the strength of the feeds increased more slowly and full strength feeds are not given until the 9th or 10th day. If the stools become relaxed the strength of the feed should not be increased for a day or two until they have improved.

These figures may be summarized in the following table.

Day	1	2	3	4	5	6	7	8	9
Amount of feed in ounces	$\frac{1}{2}$.	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	$3\frac{1}{2}$
Strength of feed . . .	water	$\frac{1}{4}$ S.	$\frac{1}{4}$ S.	$\frac{1}{2}$ S.	$\frac{1}{2}$ S.	$\frac{3}{4}$ S.	$\frac{3}{4}$ S.	F.S.	F.S.

Complementary and Supplementary Feeds.—A complementary feed is one which is given to augment a feed from the breast; a supplementary feed is one which replaces a breast feed. Complementary feeding is sometimes necessary when lactation is only slowly established. Complementary feeds are unnecessary before the 5th day as the baby may be given water to quench thirst. If the weight is still falling, or is stationary on the 5th day, or if the baby seems very hungry, test weighing may be carried out to determine exactly how much milk the baby obtains from the breast. The baby is weighed fully clothed before the feed and again after the feed is over. The difference in weight is the amount of milk taken from the breast. The second weighing must be made before soiled napkins are changed, or the result is valueless.

If the milk yield is insufficient, the baby may be offered a complement after each feed to make up the deficit. The strength of the complement should be in accordance with the age of the infant (see table) and the amount which is required may be determined by test weighing at each feed. It is probably better to offer a standard amount after each feed and let the baby take as much or as little as he wants.

CHAPTER XLIX

DISEASES OF THE NEWBORN

BIRTH TRAUMA

BIRTH injuries range from simple cutaneous trauma to severe internal hæmorrhages and may occur in normal deliveries, but are, however, more frequent in instrumental deliveries or when labour is complicated.

The prevention of birth injuries involves a consideration of the art of obstetrics and the striking of a balance between the safety of the mother and the child, when labour is difficult or complicated.

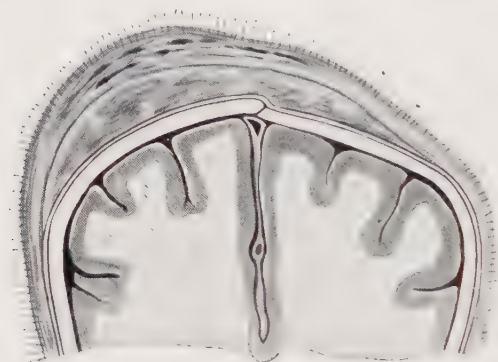


FIG. 251.—CAPUT SUCCEDANEUM.

The swelling is formed by œdema of the structures lying superficial to the pericranium. Note that it is not limited to one bone. Compare with Fig. 252.

Birth Injuries to the Head.—*Caput Succedaneum*.—This swelling is an œdema within the subcutaneous layers of the scalp often with skin ecchymoses or a deep hæmatoma. It is caused by the pressure on the head of the expanding cervix. The swelling is maximal at birth, and lies across skull suture lines and rapidly disappears within a few days. Complications may ensue when the caput involves the face when the skin is sometimes broken with consequent nursing difficulty or when secondary infection ensues. Both complications are rare.

Cephalhæmatoma (see Fig. 252).—Cephalhæmatoma is a subperiosteal hæmatoma which most commonly lies over one of the parietal bones. The hæmatoma is sometimes bilateral, but rarely affects the frontal or the occipital bones. A cephalhæmatoma never

extends beyond the limits of a single bone and is fluctuant but incompressible. It never varies in tension with crying and in these respects differs from the less common encephalocœle, which is a protrusion of the brain and meninges through a cranial defect.

The lesion is due to rupture of small vessels under the periosteum with bleeding. The blood-clot absorbs serum and the swelling increases in size for several days. Spontaneous absorption is the rule, but this may take several weeks. Ossification may take place around

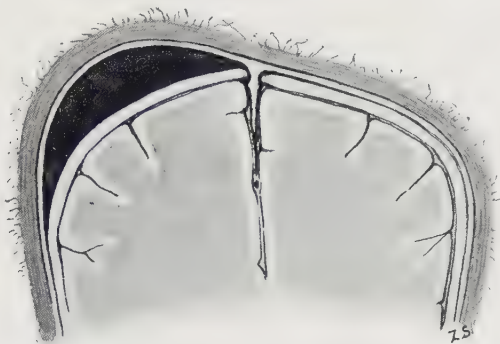


FIG. 252.—CEPHALHÆMATOMA.

The swelling is seen to consist of blood lying between the pericranium and the skull and limited to the bone on which it started by the attachment of the pericranium to the suture.

the periphery and create a crater-like depression with a raised rim which may be palpated, and a mistaken diagnosis of depressed fracture may be made. A proportion of these patients have an underlying fracture of the skull which is the cause of the cephalhæmatoma.

The hæmatoma may be apparent at birth, but usually appears on the 2nd or 3rd day of life. No treatment is necessary and any unnecessary handling should be avoided. Aspiration invites the risk of infection. The condition may cause an asymmetry of the skull which persists for many months.

Skull Fractures.—These may be depressed, linear or stellate. Depressed fractures are usually groove or spoon shaped and occur unilaterally over the parietal bone, resulting from pressure from the sacral promontory or the forceps. The lesion may be detected on routine examination or symptoms may arise from pressure on the brain or underlying hæmorrhage. Neurosurgical treatment is usually desirable with elevation of the depressed segment, evacuation and control of bleeding in cases in which symptoms arise, but in many cases the depression spontaneously resolves without treatment.

Linear and stellate fractures occur in difficult deliveries and may be asymptomatic or associated with intracranial bleeding or pressure. Treatment is indicated when symptoms are caused by pressure or hæmorrhage.

Intracranial Injuries.—Intracranial hæmorrhage has been held responsible for 40 to 60 per cent. of stillbirths and neonatal deaths. The possibility of intracranial hæmorrhage should be kept in mind in all difficult or instrumental deliveries, but especially in premature births and in prolonged or precipitate deliveries. Intracranial hæmorrhage may also occur in Cæsarean section or normal delivery.

At autopsy it is possible to demonstrate that in the majority of cases hæmorrhage within the skull usually arises from one of five separate sites.

1. Rupture of the vessels of the tentorium may cause bleeding upwards into the temporal fossa and over the surface of the brain; or posteriorly to the occipital lobes; or downwards to the cerebellum, medulla and the cord.

2. Rupture of the great vein of Galen at its junction with the straight sinus, with bleeding down to the pons, cerebellum and medulla.

3. Rupture of tributary veins from the cortex to the superior longitudinal sinus with extravasation of blood into the sub-arachnoid space over the surface of the cortex.

4. Rupture of the great sinuses is rare and usually causes stillbirth.

5. Rupture of the internal cerebral veins is rare.

The cerebro-spinal fluid acts as a cushion to the brain and permits considerable mobility of the intracranial contents, but injury occurs when excessive moulding, over-lapping, or sudden changes of pressure occur in the skull during the process of delivery.

Clinical signs.—Minor intracranial hæmorrhages must often escape recognition as they do not cause a recognizable clinical pattern and massive hæmorrhages cause stillbirth or almost immediate death. Lesions of intermediate severity create most intricate diagnostic problems in which the usual examination of the nervous system is impossible or misleading.

General symptoms and signs are often strongly suggestive of intracranial hæmorrhage; convulsions, asphyxia pallida, depression of respiration and heart-rate associated with alterations in muscular tone are frequently seen. Cyanosis or unusual pallor, fever, a shrill cry and excessive restlessness, or somnolence, may all occur. An anxious facial expression, an adder-like protrusion of the tongue and unusual yawning should suggest the diagnosis.

The tension of the fontanelle should be noted. In an extensive hæmorrhage the fontanelle may bulge, but is more usually doughy or turgid to feel.

Since the tentorium is so frequently the source of the hæmorrhage, it is convenient to differentiate the clinical pictures associated with bleeding above and below this level.

Supratentorial bleeding.—This usually affects the surface of the hemispheres and the basal ganglia. The picture is one of irritation with fullness of the fontanelle, convulsions which may be unilateral, and excessive response to stimuli of sound, light and touch. The eyes may roll upwards and the face twitch during these clonic contractions. Adductor spasm may be demonstrated. The vital centres are involved in the terminal stages.

Infratentorial bleeding.—This is often associated with early neck rigidity, opisthotonus and alteration in the rate and depth of respiration. Cyanosis is common. The baby tends to be limp and toneless and the vital centres are affected early.

Treatment of Cerebral Hæmorrhage.—It is essential that the infant should be kept quiet and warm and sheltered from any noise or disturbance which might induce further restlessness or convulsions. Avoidance of any unnecessary handling is desirable and should be restricted to essential nursing services. Respiration and full oxygenation must be maintained. These conditions are best achieved by nursing the infant in an oxygen incubator in which optimal conditions of warmth, humidity and oxygen concentration can be provided. Clothing can be reduced to a minimum inside the incubator and the infant need only be placed on a napkin to collect excreta. The baby should be kept in a quiet and darkened room. The infant should be fed in the incubator and need not be removed for any nursing services. When the baby sucks poorly or refuses feeds, then tube feeding should be given at intervals of 4 to 6 hours.

If an incubator is not available, an ordinary cot in a well warmed room will usually prove an adequate substitute.

Opinion differs concerning the position in which the infant should be nursed. It is claimed that the tendency to further bleeding is reduced when the baby is nursed propped upright on pillows but the greater comfort to the baby of lying flat probably outweighs other possible advantages.

Vitamin K (Synkavit 1 mg.) should be given by intramuscular injection to prevent the added complication of hæmorrhagic disease when bleeding has already taken place. This should be repeated on one or two occasions daily.

An infant who is restless or has convulsions should be given sedatives until the convulsions are controlled or the restlessness reduced, as these symptoms tend to provoke further bleeding. Chloral hydrate gr. $\frac{1}{2}$ to 1, or phenobarbitone gr. $\frac{1}{8}$ to $\frac{1}{4}$ may be given by mouth and repeated at intervals of 2 to 6 hours. Paraldehyde $\frac{1}{4}$ to $\frac{1}{2}$ ml. by intramuscular injection is probably more effective and appears to be well tolerated.

Lumbar puncture may prove the diagnosis by demonstrating the presence of blood in the cerebrospinal fluid but the disturbance caused to the infant is possibly harmful and the removal of fluid under pressure may provoke further bleeding.

The administration of 10 per cent. saline solution rectally has been recommended in cases in which the intracranial pressure is high and the fontanelle is bulging, but the result of this form of therapy is usually disappointing, unless the condition is due to cerebral œdema rather than to hæmorrhage.

The main principle of treatment is to maintain the condition of the infant as well as possible and avoid any unnecessary disturbance. The prognosis in cerebral hæmorrhage is always in doubt and is usually poor.

Sub-dural Hæmatoma. The sub-dural hæmatoma usually results from trauma at birth with slow bleeding into the space between the dura and the pia-arachnoid layers due to rupture of small veins crossing this space. A blood-clot forms and increases in size through further small hæmorrhages or through the lysis of clot and subsequent absorption of serum from the blood-stream. There is organization of the clot at the periphery with the development of a space occupying lesion.

Clinical symptoms may appear in the days after birth with failure to gain weight, irregular fever, vomiting and irritability. Coma or convulsions may be seen at this stage, but it is more common to find enlargement of the skull, development of hydrocephalus and fits appearing in the first few months of life. The diagnosis is made by needling of the subdural space through the lateral angles of the fontanelle. The finding of blood-stained or xanthochromic fluid in subdural tap indicates the need for repeated aspirations daily to evacuate the hæmatoma. Surgical removal of the clot and the capsule is usually necessary to avoid the sequelæ of cortical atrophy due to fibrosis of the pia arachnoid, convulsions, spasticity and mental retardation which may ensue.

Fractures of the Long Bones.—*Clavicle.*—The clavicle is the bone which is most frequently broken during delivery, usually during forceps

or breech extraction. Dislocation of the fragments, crepitus and hæmatoma are rare and the lesion is usually detected because of failure to raise the arm above the head, or because of pain, or because of callus formation after a few days. X-ray examination shows a greenstick, oblique or subperiosteal fracture and callus formation is early. The prognosis is good and immobilization of the part is only necessary when marked displacement is present.

Humerus.—Injuries usually consist of luxation at the shoulder, epiphyseal detachment or fracture of the shaft. Displacement and fracture are often difficult to detect clinically. The usual symptoms are pain and failure to use the arm.

Femur.—The femur is seldom fractured.

In all fractures of the long bones callus formation and healing are usually good, although the maintenance of position may be difficult. The subsequent growth of the bone corrects any angulation and deformity of the bone, but all fractures should be submitted to an orthopædic surgeon for his supervision.

Trauma to the Viscera.—Rupture of the liver, spleen or kidneys may occur in difficult deliveries, especially breech extraction, or hæmorrhage may occur into these viscera.

Signs of collapse or internal hæmorrhage will be seen and enlargement of the organ may be discovered, but the diagnostic problem is a difficult one.

When rupture of one of the abdominal viscera or hæmorrhage into the liver, spleen or kidney is diagnosed the infant should be given a blood-transfusion and laparotomy carried out to try to repair the lesion. The mortality is high in such traumatic lesions.

Hæmorrhage into the suprarenals may occur, especially in breech presentations. The infant may be stillborn or die soon after birth with severe shock and cyanosis. The enlarged adrenal may be palpable and, if the diagnosis can be made, treatment should consist of blood-transfusion and administration of adrenal cortical extract.

Peripheral Nerve Palsies.—*Facial palsy*.—These paralytic lesions may be central or peripheral. The central or supranuclear paralysis is very rare and leaves the muscles of the forehead and eyelid unaffected because of their innervation from both hemispheres.

Infranuclear lesions may be extracranial or intracranial, and may be caused by pressure of the forceps blade on the nerve near the stylo-mastoid foramen or within the parotid gland. In other cases the paralysis may be due to oedema, hæmorrhage or simple stretching of the nerve. Rarely the nerve is affected in a basal fracture affecting

the temporal bone. Facial palsy may be seen after forceps delivery or after spontaneous labour.

On the affected side the eye remains open, the corner of the mouth droops and the nasolabial fold is less marked than on the normal side. When the child cries the mouth is drawn to the normal side and the asymmetry of the face is exaggerated.

The treatment is expectant and in the vast majority of cases recovery occurs within a few days. In infants in whom improvement

is delayed, electrical stimulation has been recommended. Faradic stimulation is given but is probably not effective.

Brachial palsy.—Lesions of the brachial plexus may be due to simple pressure injury above the clavicle and behind the sternomastoid. In the other cases the nerve plexus is damaged when contiguous bony structures are injured. The majority of cases are due to overstretching or tearing of the nerves by traction.



FIG. 253.—FACIAL PARALYSIS FOLLOWING APPLICATION OF THE FORCEPS.

Pressure of forceps blades may produce the lesion, but it results more commonly from difficulty in extraction of the shoulders or pull on the arm. Actual rupture of the nerves is rare, but there may be hæmorrhages into the nerve sheath.

The clinical picture depends upon the nerve roots involved. C5 and C6 lesions produce a paralysed arm with internal rotation at the shoulder, clenched fingers and inability to bend the elbow. The arm lies in internal rotation at the side of the trunk or where it is allowed to fall. This syndrome is usually called the Erb-Duchenne paralysis.

If C7, C8 and D1 are affected, there is paralysis of the muscles of the forearm with wrist drop and flaccid digits, and this is called Klumpke's paralysis. Both lesions co-exist when the brachial plexus is involved in its entirety.

If the nerves have merely sustained pressure effects or have been stretched, recovery is the usual outcome, but when rupture of a nerve,

or severe hæmorrhage into the sheath has taken place, the paralysis is permanent.

Treatment is expectant, but the arm must be placed in the position which avoids stretching of the affected muscles and pull on the nerves. The arm is elevated and maintained in abduction and external rotation, with the upper arm at right angles to the trunk, the elbow bent to 90° and the wrist in extension. Plastic splints should be made to achieve this position, but first aid treatment is to fasten the back of the hand to the back of the head, or to the top of the cot with a loose bandage. Massage and manipulation is started early and electrical stimulation is sometimes employed after the 4th week. In cases which do not improve, surgical opinion should be obtained for consideration of open operation on the nerves. In cases which do not show early improvement the prognosis for complete recovery is not good.

Disturbances of the Digestive System during the Neonatal Period

Vomiting.—Vomiting is a relatively frequent symptom during the neonatal period and may arise from a variety of causes, the majority of which are not of serious consequence.

Mucus vomiting.—Many infants vomit mucus, which may be blood-stained, during the first few hours after delivery. This may persist after feeding has started and the amount of mucus in the vomit may be copious. The probable explanation is that the gastric mucosa has been irritated by material swallowed at the time of delivery with the production of an irritative gastritis.

No abnormality can be detected on physical examination, but the vomiting may be troublesome and the initial weight loss excessive.

If the vomiting is severe or persistent, treatment consists of gastric lavage with normal saline until the wash-out is clean. This may require to be repeated on several occasions until the condition settles.

Overfeeding.—Vomiting is often due to the taking of a greater quantity of food than can be retained in the stomach and the excess is regurgitated. Failure to make the baby bring up the wind after feeds often causes vomiting as the milk is brought up with the swallowed air after the baby is laid in the cot. In both instances the treatment is obvious.

Obstructive vomiting.—Vomiting which commences shortly after birth and is persistent raises the possibility of an obstructive lesion of the gastro-intestinal tract. The vomiting is frequent, non-projectile, copious and usually bile-stained, unless the obstruction is above the level of the ampulla of Vater. Abdominal distension, visible abdominal

peristalsis and constipation are usually present and are associated with a progressive loss of weight and deterioration in the general condition of the infant. These symptoms demand immediate radiological investigation and consultation with a surgeon as soon as obstruction is diagnosed. Plain X-rays of the abdomen should be taken with the infant erect and supine and will show the dilatation of the gut with fluid levels which are characteristic of obstruction. These films will yield sufficient evidence of the condition and it is neither necessary nor desirable to use opaque media such as barium for the localization of the obstruction as this may complicate surgical treatment and after care. Possible causes of obstruction which should be borne in mind are œsophageal fistula, duodenal stenosis or atresia, ileal atresia or meconium ileus.

Hiatus hernia. Frequent vomiting of the regurgitant type may be due to diaphragmatic herniation or hiatus hernia. The lesion can be shown by barium swallow when œsophageal reflux of the stomach contents may be demonstrated on screening. The condition is treated by propping up the baby after feeds in a semi-erect position in the cot. This usually produces improvement in the symptoms.

Congenital Hypertrophic Pyloric Stenosis. The development of symptoms from the obstruction caused by hypertrophy of the circular muscle of the pylorus is not common before the 2nd week of life. Male infants are affected by this condition more frequently than are females, the ratio between the sexes being 6 to 1. The symptoms are projectile vomiting, a failure to gain weight and constipation. The infant usually feeds eagerly despite the projectile vomiting which occurs at the end of feeds and will usually accept re-feeding immediately after having vomited. The vomitus does not usually contain bile.

With the continued vomiting, the condition of the infant deteriorates and he becomes dehydrated with loss of skin turgor, depression of the fontanelle and dryness of the mouth. The loss of chloride from the baby in the vomit causes a low plasma chloride level and a compensatory alkalosis.

Careful examination, with the baby well relaxed during a feed, reveals visible gastric peristaltic waves and a palpable pyloric tumour. The condition may be treated medically or by operation. Medical treatment lies mainly in the use of stomach wash-out; small easily digested feeds given at frequent intervals; and the administration of drugs to relax the spasm which may exist at the hypertrophic pylorus. Eumydrin (atropine methyl nitrate) is given 10 to 15 minutes before the feeds. The drug may be given as lamellæ containing gr. 1/750,

or as aqueous solution of 1 in 10,000 strength in doses of 1 to 5 ml. Alcoholic solution (0·6 per cent.) is given in doses of 1 to 3 minims.

Surgical treatment by Rammstedt's pyloroplasty offers a rapid relief of the condition and carries a low mortality in experienced hands. Although opinion is widely divergent on the relative merits of medical and surgical treatment the latter appears to be preferable whenever experienced surgical and nursing facilities are available.

Pylorospasm.—Some infants present with projectile vomiting similar to that seen in pyloric stenosis, but without evidence of permanent obstruction or a palpable tumour. Relief may be obtained from the use of sedatives or antispasmodics.

Other Causes.—Vomiting may be a symptom of intracranial lesions with increased intracranial pressure or cerebral irritation, or may occur with infection in any system of the body. Vomiting may be the initial and often the only sign of an infection during the neonatal period, and is often accompanied by diarrhœa.

Diarrhœa

Diarrhœa is sometimes diagnosed without justification because of ignorance of the normal variation in bowel habit of the healthy infant, but frequency of stool is not necessarily pathological.

The passage of frequent loose and watery stools, usually containing the curds of undigested milk, and often green in colour due to unchanged bile, is evidence of hurry through the gut. The presence of mucus suggests irritation of the intestinal mucosa and blood in the stool is suggestive of infection. Colic and screaming usually accompany the diarrhœa and signs of dehydration such as loss of skin turgor, loss of weight, and a sunken fontanelle are found early.

The most common causes of diarrhœa are:—

- (a) Errors in feeding, either in the quality of the food or in the amount which is given.
- (b) An excess of sugar in the feed causing fermentation in the gut.
- (c) Infection of the gastro-intestinal tract.
- (d) Parenteral infection elsewhere in the body.

Feeding Irregularities.—If the feeding of the newborn infant is increased too rapidly in the amount which is given, or in the strength of the feeds, the gut may respond by irritation and there is in consequence a hurried transit through the gut and the production of diarrhœa. Excessive fat content in artificial feeds, or too generous an addition of sugar, may be especially to blame. When diarrhœa has

been caused by such errors, relief may be obtained by reducing the strength of the feed for a period of 24 hours. Once the diarrhoea has ceased the feeds may be gradually increased in strength during the next few days. In more severe cases, a period of 24 hours on water alone, or glucose-saline before the re-introduction of milk may be necessary to restore the stools to normal. If any doubt exists as to the severity of the condition, it is usually best to eliminate milk from the diet at once and see how quickly benefit is obtained.

Excess of sugar in the feed.—Some dried milks contain a high carbohydrate content and by causing fermentation may induce a looseness of stool. Diarrhoea due to excess of carbohydrate is often frothy and the stools are very irritative to the buttocks. Colic and sore buttocks are frequently seen. The remedy lies in a change of feed to one with a lower sugar content.

Infection of the Gastro-intestinal Tract.—Diarrhoea due to the dysentery group of organisms is uncommon in the neonatal period. Occasionally infections with coliforms and other organisms of relatively low pathogenicity may occur. Contamination of feeds with staphylococci is possible and if fresh milk is not sterilized, infection with a great variety of bacteria may occur. In maternity nurseries epidemics of diarrhoea among newborn infants may be due to virus infections. Bacterial infection is usually accompanied by vomiting, diarrhoea, colic and pyrexia. The infant is usually febrile, but may early be prostrated with sub-normal temperature. The stools are loose, watery and undigested and may contain mucus, pus cells and red cells. Dehydration rapidly appears and the condition of the infant is usually poor. Acidosis, with a low alkali reserve, is frequently seen.

Infants presenting these symptoms should be isolated from all other babies immediately and in institutions should be nursed with full barrier precautions. Milk feeding should be stopped and the infant given quarter normal saline or Hartman's solution in 5 per cent. glucose instead. Feeds should be given frequently in small amounts at intervals of 2 or 3 hours and the total daily intake should be approximately 3 ounces per pound body-weight, the excess being necessary to make good the additional fluid loss caused by the diarrhoea. Should vomiting persist, or the baby become further dehydrated despite this treatment, it will be necessary to give fluids by subcutaneous or intravenous infusion.

Stool cultures must be taken at the onset to determine the infecting organism and sensitivities to antibiotics. Antibiotic therapy must be started without awaiting the result of these tests. The prognosis in such cases must always be guarded.

Epidemic Diarrhœa of the Newborn.—There is considerable evidence to suggest that this is caused by a virus of high infectivity. The clinical picture is at first one of anorexia followed by diarrhœa, but with little vomiting. The temperature may be normal or slightly raised. The stools tend to be watery, yellow and acid, but seldom contain mucus, pus cells or blood. The stools are voided in explosive fashion. Dehydration and acidosis rapidly develop and weight loss is considerable. The condition of the infant may deteriorate rapidly and the need for rehydration may early become urgent. The condition may improve only to relapse during treatment and the infant may develop intercurrent infections of the lungs, ears or septicæmia.

The infectivity is high and the disease may spread in nurseries in epidemic form. Isolation and full barrier nursing is essential as soon as the diagnosis is suspected.

The treatment is symptomatic. Initial cessation of milk feeding, with oral, subcutaneous or intravenous administration of electrolyte containing fluids to combat dehydration and acidosis, form the basis of therapy. When diarrhœa ceases a gradual return to feeding may be made. The prognosis is grave.

Parenteral Infections.—Diarrhœa and vomiting may be symptoms of infection outside the gastro-intestinal tract, such as pyelitis. A search for such an infection must always be made when diarrhœa occurs and the diarrhœa will cease when the infection is brought under control.

Colic.—Colic is manifest by screaming, flushing of the face, clenching of the fists, flexing of the legs and arms and tenseness of the abdominal wall. The common causes are distension of the gut with wind or spasmodic contractions of the gut due to some irritative stimulus. Swallowing of air and failure to dewind is the most common cause, but improper feeding or some mechanical obstruction such as volvulus or intussusception may occur.

Treatment during an attack should be directed to removing the cause. The bringing up of wind, the passage of flatus or a motion, and the application of warmth to the belly may afford relief. Elimination of the cause, whether it is ærophagy or improper feeding, will prevent recurrence in most cases.

Constipation

True constipation in the newborn infant is comparatively rare. Mechanical causes such as gut atresia present as emergencies and should be treated appropriately. Hirschprung's disease and congenital

megacolon do not usually give rise to marked symptoms during the neonatal period, although delay in the passage of the first meconium and abdominal distension may be the earliest signs of these conditions.

Constipation in this age group is usually a variation in the normal bowel habit and the passage of hard motions at irregular intervals is most commonly the result of insufficient intake of fluid or food, or the use of artificial feeds which are too rich in protein or too low in sugar content.

Treatment should be directed to the correction of the dietetic error and the administration of extra water. More severe constipation may be relieved by a glycerine suppository, the old-fashioned soap stick or by a small water enema. Purgatives and aperients are to be deprecated, even the mildest such as milk of magnesia. As the cause is nearly always an inadequacy of diet or fluid intake, it is rational that the treatment should be by correction of this error.

HÆMORRHAGIC STATES IN THE NEWBORN

Hæmorrhagic Disease of the Newborn.—This condition shows in an unusual tendency to spontaneous and prolonged bleeding in the first week of life, usually from the 2nd to the 5th day. The common site of hæmorrhage is the gut, but the lungs, brain, skin, mucous membranes, umbilical cord and vagina may be affected. The bleeding coincides with the period of low prothrombin level which occurs in the newborn infant from the 2nd to the 7th day, when the level may fall to 20 per cent. of normal, but some other factor must also be involved. Bleeding and clotting time and platelet level may be abnormal and the prothrombin level is reduced when the condition exists. The prothrombin can be restored to normal by the administration of vitamin K, but not every case of hæmorrhagic disease responds to this treatment. In such instances a small fresh blood-transfusion arrests the hæmorrhage. Excessive administration of vitamin K should be avoided, as it increases the liability to jaundice. It is unnecessary to give more than 1 mg. daily in most cases.

The clinical signs and symptoms depend on the system involved, but the condition presents most commonly as vomiting of blood, or melæna.

Because of the possibility of the occurrence of this condition, which is not common, it is wise to avoid elective surgery in the newborn before the 8th day of life. If surgery is necessary, vitamin K (synkavit 1 mg. intramuscularly) should be given daily until the prothrombin level is normal. Fresh blood should be available in case bleeding is not controlled by vitamin K administration.

Umbilical Bleeding.—This is most frequently due to a slipped ligature or to infection of the stump. A brisk umbilical hæmorrhage may endanger life as every ounce of blood lost is equivalent to approximately 10 per cent. of the baby's total blood-volume. It may be possible to stop the hæmorrhage by tying a fresh ligature around the cord. If the cord has separated, the bleeding point may be brought under control by pressure or it may be possible to stop the bleeding with a pair of artery forceps. Urgent transfusion may be required in cases in which umbilical bleeding occurs. The total blood-volume of the newborn infant is only about 10 ounces and a loss of blood amounting to 2 ounces may constitute a dangerous hæmorrhage.

Hæmophilia.—This rare disease may produce trouble, especially after circumcision, but is excessively rare in the neonatal period.

Thrombocytopenic Purpura.—A congenital thrombocytopenia is sometimes seen with a petechial rash, ecchymoses and bleeding.

Vaginal Bleeding.—A vaginal loss is not infrequent and is not serious unless it is due to hæmorrhagic disease. A more usual cause is a hormone withdrawal effect, when no active treatment is necessary, and the condition is often referred to as neonatal menstruation.

JAUNDICE IN THE NEWBORN INFANT

Jaundice in the neonatal period may be due to a variety of causes.

Physiological Jaundice or Icterus Neonatorum Simplex.—At birth the baby has a high hæmoglobin and red cell count. The normal values at birth are hæmoglobin 120-140 per cent. and a red cell count up to 6 million per c.mm. This polycythæmia is necessary *in utero* to ensure adequate oxygenation *via* the placenta, but once normal respiration is established, the extra red cells are unnecessary and a rapid fall in hæmoglobin and red cell count takes place during the first week of life. The red cells are destroyed and the iron is stored in the liver. The bilirubin formed is normally excreted by the liver but, if a relative immaturity of the liver co-exists, the liver is unable to eliminate the bilirubin as rapidly as it is formed and jaundice occurs.

Physiological jaundice usually appears on the 2nd or 3rd day of life and may last for only a few days or until the 10th day. The skin is lemon yellow in colour, but the conjunctivæ show staining only in severe cases. The liver and spleen are not increased in size and the stools remain normal in colour. The jaundice is not associated with fever or constitutional upset, although the infant may be sleepy and

less eager for food. No special treatment is required and the prognosis is entirely favourable, except in small premature infants when kernicterus may occasionally occur.

Sepsis.—Sepsis, especially when accompanied by septicæmia, is a cause of jaundice and anæmia appearing after the first few days of life. The signs, symptoms and treatment are those of the primary infection.

Syphilis.—Congenital luetic infection may cause a syphilitic cirrhosis with jaundice.

Congenital Atresia of the Bile Ducts.—This developmental anomaly is rare and may be partial or complete. Jaundice appears at the end of the 1st week of life or later and is said to be of olive green hue. The liver progressively enlarges and the stools become white, while the urine contains bile. These patients should always be submitted to laparotomy as a certain number have an extra-hepatic atresia which is reparable surgically. The condition is otherwise progressive and has a fatal outcome although the infant may live for many weeks or months.

Erythroblastosis Fœtalis (*Icterus gravis neonatorum*; *Hæmolytic disease of the newborn*).—Landsteiner and Wiener in 1939 showed that the red cells of 85 per cent. of white people contain an agglutinin which they named the Rhesus factor because of the similarity to an antigen found in the red cells of the Rhesus macacus monkey. Individuals possessing this factor are called Rh-positive and the remainder Rh-negative.

Transfusion of Rh-positive blood to a Rh-negative recipient stimulates the production of an agglutinin in the recipient's serum called the anti-Rh antibody. This is a true agglutinin and if a second transfusion of Rh-positive blood is given to a sensitized individual the agglutinin already present in the patient's serum causes agglutination and hæmolysis of the transfused cells. Such transfusion reactions are severe and often fatal.

Rhesus Factor in Pregnancy.—The Rhesus factor is not a single substance, but is a complex of antigens, a number of separate genes having been demonstrated. For all practical purposes this complication may be ignored and individuals considered simply as Rh +ve (D + ve) or Rh - ve (D - ve), according to whether their cells contain a Rhesus antigen or not.

An additional complication exists in the occurrence of homozygous and heterozygous Rh +ve individuals. The Rhesus blood group of

an individual is determined by the ovum and the spermatozoon which unite to form the zygote from which the individual grows. If both the ovum and the spermatozoon carry the Rh +ve gene (Rh), the individual will possess the Rhesus genotype Rh Rh and all his or her germ cells (spermatozoa or ova) will carry the Rh +ve (Rh) gene. This is a homozygous Rh positive individual.

If the individual is a heterozygous Rh positive, his Rhesus genotype is Rh rh. The individual will group as Rh +ve as Rh is dominant over rh. His or her germ cells (ova or spermatozoa), however, only carry half of the gene pair which make up the chromosome and half the germ cells will carry the Rh +ve (Rh) gene and half the Rh negative (rh) gene.

The mating of a Rhesus positive man with a Rhesus negative woman may, therefore, result in the following offspring.

Result of pregnancy.—The mating of a homozygous Rh +ve father with a Rh negative mother must result in a Rh positive foetus, while the heterozygous Rh +ve father and Rh -ve mother may have either a Rh +ve or Rh -ve infant.

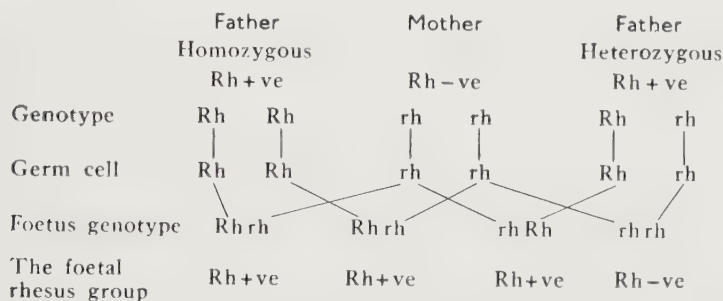


FIG. 254.—MATING OF HOMOZYGOUS AND HETEROZYGOUS MALES WITH RH NEGATIVE WOMEN.

Sensitization of the mother.—The Rhesus positive foetus carried in the womb of the Rhesus negative mother may pass the Rhesus antigen across the placental barrier into the serum of the mother. The foreign antigen will provoke the Rhesus negative mother to produce Rhesus antibodies and these in turn are passed back across the placenta to attack the Rhesus positive red blood-cells of the baby. This results in agglutination and destruction of the baby's cells during intra-uterine life.

The chances of marriage between a Rhesus positive man and a Rhesus negative woman are 11 per 100 in white populations. It has been demonstrated that only 5 per cent. of Rhesus negative women

actually become sensitized to the Rhesus antigen through pregnancy and produce antibodies. Transfusion with Rhesus positive blood may produce sensitization in nearly 50 per cent. of Rhesus negative women.

The first baby produced by the mating of a Rhesus negative woman and a Rhesus positive man does not suffer from erythroblastosis foetalis unless sensitization has been caused by a previous transfusion or by a miscarriage. The second infant may be affected in about 5 per cent. of cases and in subsequent pregnancies the likelihood of affected babies increases with each pregnancy, although the outlook is greatly improved if the father is heterozygous.

The incidence of the disease is not greater than 1 in 125 births and may be much less than this figure.

Various factors appear to influence the likelihood of this occurrence. The different Rh positive genes, of which there are at least 7, appear to have different ability to provoke antibody production in the mother. Differences in placental structure permit greater or lesser leakage of the antigen into the maternal circulation and different women appear to vary considerably in their ability to produce anti-Rhesus antibodies in response to the same stimulus. The degree to which the mother is affected by this process can be measured by estimating the titre of antibodies in the serum during pregnancy when a rise in antibody titre usually indicates an active sensitization.

The first pregnancy of such a mating may stimulate the production of antibodies, but only to a level which is insufficient to affect the infant clinically. These antibodies persist in the maternal serum after term and the next Rh +ve foetus causes further antibody production to a level which may produce erythroblastosis in the foetus. In such cases, subsequent pregnancies almost invariably result in severely affected babies. The exception occurs when the father is heterozygous and chance may produce a Rhesus negative baby in the middle of a series of affected ones. Rhesus incompatible blood-transfusion appears to carry a greater power to produce antibodies in the woman than does a pregnancy with a Rh +ve foetus.

Management of Erythroblastosis Foetalis.—No female, from the moment of birth to the end of the child-bearing period, should be given a blood-transfusion or whole blood injections without determining her Rhesus group and the use of Rhesus compatible blood for the transfusion. Even in infancy, the administration of Rh positive blood to a Rh negative female may sensitize her to antibody production and jeopardize her chance of ever bearing a healthy infant. In an emergency, when Rhesus grouping cannot be done, Rh negative blood should be given.

Every pregnant woman should have her Rhesus blood-group determined as part of the antenatal care. Rhesus negative women should be tested for antibodies at the 12th and 30th week of pregnancy when the presence of antibodies will indicate the possible involvement of the foetus with erythroblastosis.

It is unusual for the baby to be affected in the first pregnancy, but if subsequent mating of a Rh positive man and a Rh negative woman are proposed, trouble may be anticipated. The father should be grouped to see if he is homozygous or heterozygous as this will influence the prognosis for a successful outcome of the pregnancy.

In second or later pregnancies, serial estimation of the antibodies may give some indication by a rise in titre whether the baby is likely to be affected, but the degree of involvement of the foetus is not directly related to the antibody titre. In any pregnancy in which antibodies are present, preparations to treat an affected baby should always be made in advance and the delivery should be conducted in hospital. When an affected baby is expected it may be helpful to induce labour between the 34th and 38th weeks but this is debatable; because the extra hazard of prematurity will affect the prognosis for the infant.

Clinical Features of Erythroblastosis Foetalis.—The basic process in erythroblastosis foetalis is agglutination and hæmolysis of the foetal cells by the antibody passed across the placenta from the maternal serum. This blood destruction is balanced by a hyperplasia of erythropoietic tissue in the foetus, both medullary and extra-medullary, to maintain a normal cell count. The result of the pregnancy depends on whether the production of cells can keep pace with the destruction, and on the severity of the hæmolytic process. In mildly affected cases, the baby at birth appears normal. After several hours or days, jaundice, anæmia and hepato-splenomegaly may appear.

In more severely affected infants the liver and spleen may be enlarged at birth and jaundice and anæmia appear almost at once. The anæmia and jaundice may develop rapidly and to a profound degree; death may occur within a matter of hours from the severe degree of anæmia. Jaundice is rarely present at the time of birth although the liquor and the surface of the skin may be stained yellow.

In the most severe cases, the infant may be stillborn, or death may occur *in utero* before term with hydrops foetalis.

Hæmatological study of the infant at birth by examination of the cord-blood confirms the diagnosis and indicates the severity of the involvement by the hæmolytic process. The following tests should be carried out on a sample of cord blood obtained at the time of delivery.

Cord-blood hæmoglobin.—In affected babies the cord-blood level of hæmoglobin may be normal with levels of 110 per cent. or above and the infant may develop anæmia and jaundice after an interval of some hours. These are mild cases. In severely affected infants the hæmoglobin level at birth may be low and values at any level from the normal figure down to 40 per cent. may be found.

Rhesus grouping.—Rhesus grouping of the cells of the infant will confirm whether Rhesus incompatibility is present, and the antibody titre of the serum should be determined. Coomb's test is a demonstration whether the infant red cells have been sensitized by absorption of globulin, *i.e.* antibody. A positive Coomb's test indicates that hæmolysis will occur and the strength of the Coomb's reaction indicates the probable severity of the hæmolytic process.

Nucleated red cell count.—This is quoted as the number of nucleated red cells (erythroblasts) per 100 leucocytes. High counts indicate a considerable hyperplasia of the marrow and indicate that extensive intra-uterine hæmolysis has occurred. A low erythroblast count with considerable anæmia at birth suggests marrow exhaustion.

Serum bilirubin levels.—The serum bilirubin levels are raised in affected babies and, as the level of bilirubin in the first few days bears a close relation to the risk of kernicterus, all untreated babies must be watched for the onset of jaundice. Exchange transfusion should be carried out if the serum bilirubin exceeds 20 mg. per cent.

Treatment of Erythroblastosis Fœtalis.—The problem of treatment lies in the fact that the affected baby at birth has a proportion of his red cells already sensitized and destined for hæmolysis and has in his serum a certain quantity of antibody which will destroy further red cells. This process continues until the antibody has all been absorbed or eliminated. This hæmolysis produces an anæmia which marrow over-production attempts to make good and the survival of the infant depends on whether this balance can be maintained.

The infant should be transfused with Rh negative blood which will not be affected by the serum antibodies and which will therefore survive to combat the developing anæmia. In mild cases this form of therapy will suffice and repeated transfusions are given whenever the hæmoglobin falls to an arbitrary level, *e.g.* 70 per cent. This is repeated until hæmolysis ceases and all the antibody has been eliminated.

In severe cases exchange transfusion is indicated. A polythene catheter is passed into the umbilical vein to reach the inferior vena cava. By a system of three-way taps and a syringe, blood is alternately withdrawn and replaced through the catheter by equivalent volumes

of Rh negative blood. By the use of 15 to 25 such exchanges, it is possible to remove 90 to 95 per cent. of the infant's red cells and replace them with Rh negative cells which are unaffected by antibodies and can survive. At the same time a large proportion of the baby's plasma and the antibodies are removed and replaced by normal plasma. It is usual to continue exchanges until a total volume of blood equal to 80 to 100 ml. per pound body weight has been transfused.



FIG. 255.—APPARATUS FOR EXCHANGE TRANSFUSION.

This technique is usually practicable through the umbilical vein within the first 24 hours of life. If successful, the baby is spared a considerable degree of jaundice; the effects of anæmia; and the drain on the resources of the marrow is greatly reduced.

The indications for exchange transfusion are debatable and usually take note of the strength of the Coomb's reaction, the hæmoglobin level in the cord blood, the serum bilirubin and the history of previous pregnancies. The present trend is to carry out an immediate exchange transfusion if the cord hæmoglobin is below 90 to 95 per cent. or if the Coomb's reaction is strongly positive, especially when there is a bad obstetric history. A cord-blood bilirubin over 2.8 mg. per cent. is also an indication for exchange transfusion.

Prognosis.—When one baby has been affected and the father is homozygous, subsequent babies will be more severely affected and the

prognosis is grave. If exchange transfusion can be carried out, the chances of survival are good. After a successful exchange transfusion the baby may show no further symptoms of anæmia or jaundice. In many cases, however, the infant may show anæmia or deepening jaundice in the period following transfusion. Serial bilirubin estimations must be carried out at eight or twelve hour intervals if the jaundice deepens and re-exchange transfusion performed if the bilirubin level reaches 18 to 20 mg. per cent. The development of Kernicterus is likely if the serum bilirubin exceeds this level. Exchange transfusions may be necessary on two or three occasions within the first four or five days of life. When the umbilical vein thromboses, the catheter can be introduced into the femoral vein through the long saphenous vein, exposed in the upper thigh by a cut down technique. Kernicterus is an added complication which occurs in some infants and is due to damage to the cells of the basal ganglia with bile staining. This is probably a sensitization of the basal ganglia cells and leads to extrapyramidal rigidity, spasticity and, when the baby survives, often mental defect.

ABO and Other Group Incompatibilities.—Only 90 per cent. of the cases of erythroblastosis foetalis can be demonstrated to be due to Rhesus incompatibility and the remainder are due to differences in the ABO, M or N, S, Lu, Kell or Duffy blood groups in the parents.

The indications for treatment are similar to those for erythroblastosis foetalis due to the Rhesus factor.

CONGENITAL MALFORMATIONS

The cause of congenital abnormalities occurring in the foetus remains doubtful. Some of these malformations are genetically determined, while others have been attributed to pressure effects associated with the intra-uterine position of the foetus. A possible cause of congenital defects may be a disturbance in the nutrition or metabolism of the foetus during the early weeks of intra-uterine life, but the mechanism of such disturbances is little understood. This interference with normal development may be due to placental hæmorrhage, maternal virus infection or other intercurrent disease. Rubella affecting the pregnant woman has demonstrated how the foetus may suffer from congenital defects as a result of the infection. Infection of the mother during the first 12 weeks of gestation may cause congenital heart lesions, eye lesions or deafness in the foetus. The tissue which is most actively growing at the time when the maternal health is disturbed is most likely to show the congenital defect.

The congenital malformations which may occur in the baby are numerous and varied. The majority of these lesions do not endanger life and may be susceptible to cosmetic surgery at a later date. Some lesions are incompatible with life and there is no treatment which can remedy the defect. The lesions which are important during the neonatal period, therefore, are those which endanger life but which, with prompt intervention, can be remedied. One or two of these conditions will be discussed.

Tracheo-oesophageal Fistula or Atresia.—Interference with the normal development of the oesophagus usually results in a failure of canalization or atresia. The lesion is usually at the level of the tracheal bifurcation and is often associated with a fistulous connexion between the atretic oesophagus and the trachea.

Difficulty in swallowing is usually found with the first feed. Regurgitation occurs or, if the fistula connects the upper part of the oesophagus with the trachea, the feed pours into the trachea and causes choking.

As soon as the diagnosis is suspected, all feeds are withheld and the condition confirmed by the passage of a catheter down the oesophagus when it is held up at the level of the obstruction. Radiological confirmation is obtained by introducing 1 ml. of lipiodol into the oesophagus and taking an X-ray in the erect position when the dye is seen to be held in the blind pouch or passing down the fistula to the lungs. Immediate surgery with closure of the fistula and restoration of the continuity of the oesophagus offers a fair chance of success.

Intestinal Obstruction.—Atresia of the intestine is not uncommon. Duodenal atresia, stenosis or diverticulum, may occur, but solitary or multiple atresia of the small gut is the most common lesion. The large gut is less frequently the site of atresia or stenosis.

The symptoms indicating intestinal obstruction are delay in the passage of meconium, abdominal distension and vomiting, often bile stained, usually within the first 24 hours of life. Plain X-rays of the abdomen will show the fluid levels and gut distension of an obstruction, but are seldom helpful in localizing the site of the lesion. Immediate laparotomy should be undertaken and may reveal a condition susceptible of repair. Full antibiotic cover and intravenous feeding are essential for survival after surgical repair of the lesion.

Imperforate Anus.—This condition will be discovered at the time of the first physical examination or when the rectal temperature is taken. There are several varieties of the condition and the gap

between the anal dimple and the blind rectal pouch may be only membrane thick or several centimetres wide. The rectal pouch may open through a fistula into the vagina, urethra or bladder. Investigation must be undertaken to determine which type of lesion is present and surgical opinion sought. It may be possible to restore normal gut continuity at once or a colostomy is performed and plastic procedures carried out at a later date. A plain X-ray of the abdomen with the patient upside down may show the distance which exists between the gas in the rectum and the anal dimple. This influences the surgical approach.

Hare Lip and Cleft Palate.—Failure of mid-line fusion of the premaxilla and palate may cause a variety of lesions. The upper lip may show clefts and there may be a mid-line defect of the palate. This may affect only the soft palate, or may also affect the hard palate. The cleft may extend forwards and involve the maxilla also. These lesions create difficulty in feeding, either by affecting sucking or by permitting milk to enter the nose and cause choking. Various shapes of teats with flanges to occlude the palatal defect have been evolved, but are not entirely successful. Spoon feeding is often successful, but tube feeding is sometimes essential. It may be necessary to undertake surgical repair at a very early stage, but it is preferable to delay this until the infant is at least 10 pounds in weight.

Talipes Equino-varus.—The intra-uterine foetal position tends to produce this deformity which only seldom persists after birth. When true adduction is present it should always be treated early. Manipulation, strapping or fixation of the affected part by an orthopædic surgeon is desirable. Less severe cases may respond to manipulation several times a day. In either case, treatment must be started at the earliest possible moment.

Spina Bifida and Meningocœle.—Failure of fusion of the vertebral arches permits herniation of the meninges at any level in the spinal column, usually in the lumbar area. The herniation may be covered by skin or only by a bluish membranous roof and the sac may include nerve roots or spinal cord (meningo-myelocœle). When the skin covering is defective, the cerebro-spinal fluid may leak and meningeal infection is frequent. The prognosis is best when there is no evidence of paralysis of the lower limbs or loss of sphincteric control or anal tone. When skin defects exist, but there is no paralysis, surgical repair is often attempted. If surgery is to offer any hope of success, immediate prophylaxis against infection must be undertaken. No

dressing should be applied. A large rubber ball is cut in two and sterilized. The dome of one half of the ball is placed over the meningo-coele and kept in place by a bandage. The infant is nursed on his face, full antibiotic cover is given and surgical aid enlisted.



FIG. 256.—X-RAY SHOWS TYPICAL APPEARANCE OF HYDROCEPHALUS.

Note wide separation of bones of the vault of the skull; also the large size of the foetal head in comparison with other foetal bones.

Hydrocephalus. The baby may show enlargement of the head at birth, or the condition may be present to such a degree as to cause difficulty in delivery. Hydrocephalus is caused by an obstruction to the normal circulation of the cerebro-spinal fluid which is often due to a congenital abnormality of the brain, the head is large and the sutures and fontanelles wide. The skull is globular in shape and appears relatively enormous in comparison with the small triangular face, with bulging of the forehead and above the ears. There is sometimes an associated spina bifida or meningocele. Some cases are susceptible to neurosurgical treatment, but the outlook is poor.

Anencephaly.—The vault of the cranium and brain are absent. This deformity is often associated with spina-bifida and other malformations. It is incompatible with life. An anencephalic foetus presents either by the face or breech.



FIG. 257.—ANENCEPHALY.

Note the absence of the vault of the foetal skull.

Congenital Heart Lesions.—These are discussed elsewhere. Exact diagnosis and prognosis is particularly difficult at this age.

INFECTION IN THE NEWBORN INFANT

The newborn infant has a low natural resistance to infection and may succumb to infections which are of low pathogenicity to adults, the organisms being carried by attendants who have themselves no symptoms. For this reason, carriers of streptococci in the throat or

individuals suffering from low grade staphylococcal infections or head colds represent a great potential danger to infants in their care.

The response to infection which is shown by the newborn infants is very different from that shown by older children. The symptoms which denote neonatal infection are seldom local, but are general and merely indicate a general deterioration in health. It must be emphasized that the onset of many serious infections in the newborn infant is often insidious and the infection may be well established before it is realized that the infant is gravely ill.

Some degree of vomiting and diarrhoea are commonly seen in infants suffering from infection which is remote from the gastrointestinal tract. Anorexia or refusal to feed is a common early symptom in generalized infection; lethargy and sleepiness are frequent.

The temperature response to infection is seldom marked and quite a severe infection may cause a rise in temperature of only 1° . Very severe infections may sometimes cause a subnormal temperature, slow pulse-rate, reduced respiration-rate, marked sleepiness and collapse without localizing signs. Tachycardia is often a more important sign than fever.

The symptoms do not always point to the site of the infection and the general signs and symptoms which indicate that infection has occurred necessitate a careful clinical search for the lesion. Frequently the aid of the laboratory is required to localize the infective process. Examination of the urine, throat or umbilical swab, blood-culture and sometimes lumbar puncture may be necessary to determine the nature of the infection and should be carried out when a diagnosis of infection is made without localizing signs.

Respiratory Tract.—*Head cold and nasal catarrh.*—When a young infant contracts a cold in the head, the secretions in the nose may cause embarrassment during feeding and the infant may be snuffly and fretful at this time. The real danger to the infant lies in the normal resting position of the infant on his side or on his back. The infected secretions drain down the back of the throat and with the poor cough reflex of the infant may overcome the barrier of the larynx and cause an infection of the lung.

Otitis media.—The same anatomical considerations affect the middle ear and the relatively wide and straight Eustachean tube permits an easy channel for ascending infection, infected secretions or vomited material. The symptoms are those of low grade fever, irritability and general malaise and the infection is found only on full routine physical examination of the infant. Examination of the tympanic membranes is an essential part of the routine examination of the ill

baby. Spread of the infection to the mastoid air cells is relatively easy and meningeal infection may follow by spread of infection through the spongy bone or by the veins.

Early diagnosis and the appropriate antibiotic therapy is essential; myringotomy and mastoid operations are carried out when indicated.

Pneumonia.—Primary pneumonia is rare and the infection is usually a descending spread from the upper respiratory tract to the lung which has already shown a mechanical lesion such as atelectasis or a lesion caused by the inhalation of mucus, food or vomitus.

Cough is an uncommon symptom in infancy and attention is usually drawn to the lesion by a rising respiration-rate, cyanosis, pallor or a slight rise in temperature, associated with anorexia and general malaise.

Examination of the chest may show little that is abnormal and alterations in percussion note and air entry are hard to determine. The presence of showers of fine rales is the most frequently detected abnormality and may represent the sum total of the physical signs.

The essentials of treatment are to maintain full oxygenation which usually requires an oxygen tent, to ensure an adequate fluid intake, and the use of the appropriate antibiotic. Nose and throat swabs should be taken to isolate the offending organism and to determine the sensitivity to antibiotics.

Pyothorax.—This may complicate pneumonia, especially when a staphylococcal infection is present.

Gastro-intestinal Infections.—These have been discussed elsewhere (p. 689).

Mouth.—Infection of the buccal mucous membrane and the tongue by thrush is not infrequent in bottle fed or debilitated infants. The fungus (*öidium albicans*) grows in the mucous membrane of the mouth and shows as greyish-white plaques and shreds which resemble milk curds, but which cannot be wiped off with gauze. The constitutional upset is usually slight, but the soreness of the mouth during the invasion stage and before the lesions are easily seen, may cause the infant to refuse feeds. Rarely, the fungus infection spreads down the gastro-intestinal tract and causes thrush oesophagitis, gastritis or enteritis; occasionally sore buttocks may be caused by thrush. During antibiotic therapy the lungs may be involved by the fungus which multiplies under cover of the antibiotic in the absence of the normal bacterial flora.

The fungus is frequently present in the vagina of pregnant women and this may represent the source of infection.

Treatment is by the local application of glycerin and borax to the affected mouth before and after feeds, or by the use of 1 per cent. gentian violet in aqueous solution twice a day. Monsol 1 in 200 or merthiolate 1:10,000 may be employed. These lotions should be applied with a wool swab on a stick rolled over the affected mucous membranes. Nystatin therapy may be indicated when a generalized thrush infection is present.

Infection of the Urinary Tract.—This is equally as common in the male infant as in the female.

Pyelitis and pyelonephritis.—Symptoms suggestive of infection without physical signs should always promote a search for a urinary infection. The culture of a clean specimen of urine in the newborn infant often shows coliform organisms, but this should not be taken as evidence of urinary infection unless many pus cells are also present.

Coliform bacilli, pus cells, red cells and casts in the urinary deposit in an ill baby may indicate pyelonephritis or be a manifestation of generalized septicæmia.

There are usually fever, anorexia and sometimes vomiting and the infant may have a grey appearance suggesting anæmia. Local renal tenderness is seldom detectable.

Septicæmia.—This is not uncommon in the newborn infant, following skin or umbilical infection. The general symptoms of infection with fever, splenomegaly and urinary changes indicate the diagnosis. Blood-culture should always be carried out at the earliest suspicion.

Meningitis.—Infection of the meninges seldom presents in classical form and may be present without definite physical signs. Lumbar puncture is always justified when signs of infection are present without localizing symptoms or signs. Coliform bacilli are often responsible for meningitis at this age, but any of the common bacteria may be found.

Skin Sepsis

A small pustular eruption due to staphylococcal infection is the type of skin sepsis which occurs most commonly in the newborn infant. The soft and moist skin of the infant is easily traumatized by clothing or rubbing with the towel after the bath. The infecting organism may be present in the nose or on the skin of nurses or doctors, or may be transferred from other infected babies. The napkin area is moist and is often the initial site of the infection. The danger of staphylococcal infection of the skin is greatest when the area around the raw umbilical site is involved.

Pemphigus neonatorum is a bullous or vesicular eruption in the skin with large fluid-containing blisters which raise the outer skin layers. The epithelium covering the vesicle is easily rubbed off leaving a raw area which can easily become secondarily infected. Pemphigus may be due to congenital syphilis, but is more commonly streptococcal in origin. In syphilitic pemphigus the palms of the hands and the soles of the feet are involved and often signs of congenital syphilis are present.

In streptococcal pemphigus the lesions may spread and produce an exfoliative dermatitis with the major part of the body surface denuded of epithelium. The infant shows marked toxæmia, and the condition carries a grave prognosis.

Erysipelas may occur and often starts as a streptococcal infection at the umbilicus which spreads over the abdominal wall.

Skin infection usually requires the appropriate antibiotic treatment and it is usually wise to administer this systematically. Local applications may produce sensitization rashes. When possible, a swab should be taken for identification of the organism and for sensitivity tests, especially in staphylococcal infections.

Infections of the Eye.—A purulent conjunctivitis with profuse discharge usually occurs during the latter part of the first week of life. The organism is usually a staphylococcus, but diphtheroids may also be found. A certain proportion of such infections show no organism on culture.

The palpebral conjunctiva is usually affected and is red and oedematous and the swelling of the lids may cause difficulty in examination of the eye, and in treatment.

A swab must be taken for culture and sensitivities before treatment is started. Albucid drops of 10 per cent. strength may be used 3 times a day, or penicillin eye drops (2,500 units per ml.) used instead. Penicillin eyedrops may be used 4-hourly or a concentrated course may be given. In cases which are penicillin resistant, 1 per cent. aureomycin eye ointment or 0.4 per cent. chloramphenicol drops may effect a cure.

Apart from the use of eyedrops, the only local treatment which is required is to wipe the palpebral fissure clear of discharge with a wool swab soaked in normal saline. The infection usually clears within a few days under treatment.

Dacrocystitis.—Blockage from failure of canalization of the nasolachrymal duct causes spilling of tears from the eye, a sticky eye usually indicating a superadded infection. Pus may sometimes be expressed from the duct by pressure in the angle between the inner

canthus and the nose. Gentle massage of this area with the tip of the little finger several times a day in addition to local antibiotic therapy will usually clear the condition, but the massage should be continued for several months before probing of the duct is undertaken by an ophthalmic surgeon.

GENERAL TREATMENT OF INFECTION OF THE NEWBORN

Three main principles of treatment must be observed.—1. The general condition of the infant must be maintained and alterations made in the feeding routine to suit the needs of the infant. A change to a more dilute or more easily digested feed may be necessary. In severe infections expressed breast milk is of great value if it can be obtained. Feeds may be given in smaller amounts at shorter intervals when the infant tires easily or becomes exhausted with a large or lengthy feed. Care should be taken to ensure that the total daily intake is sufficient for the infant's needs and compensates for any unusual losses by diarrhoea.

When the infant is unable to take adequate fluid by mouth, it may be necessary to supplement this by subcutaneous or intravenous infusions.

When anæmia occurs during an infection, great benefit may be derived from a small transfusion of 50-100 ml. of fresh blood.

2. Full oxygenation must be maintained and the temperature kept within reasonable level by the application of warmth or cooling if hyperpyrexia is present.

3. Control of the infection by the use of the appropriate antibiotic. The range of bactericidal drugs is very wide and, if the organism which is causing the infection is known and the sensitivity has been determined, the correct drug for the individual can be employed.

In the newborn infant it is not desirable to await the results of these laboratory investigations, which will take at least 48 hours, before initiating treatment. It is essential that empirical treatment should be begun as soon as the signs of infection have been detected and the antibiotic which is most likely to overcome the infection should be given in suitable dosage.

The dosage of the different antibiotics which is used during the neonatal period is very wide, but the following dosage is appropriate:—

Sulphonamides.—Sulphatriad, sulphadiazine, sulphathiazole, sulphadimidine (sulphamethazine) or sulphasoxazole (Gantrisan) may all be given, but the two latter are probably the most useful. These drugs

are given orally and the dosage employed is $\frac{1}{2}$ -2 grains per pound body-weight in the 24 hours. The total dosage is given in 4 divided doses at intervals of 6 hours in the form of a suspension of the drug. Sulphonamides are effective against some strains of staphylococci, streptococci, pneumococci and coliform bacilli. The insoluble sulphonamides are employed in gut infections and achieve a high concentration within the lumen of the gut, but with little absorption into the blood-stream. The drugs which are commonly employed are the suspensions of sulphaguanidine and sulphasuccidine in daily dosage of 1-6 grains per pound body-weight divided into 4- or 6-hourly doses.

Penicillin.—Penicillin may be given by intramuscular injection or by mouth. Oral administration appears to achieve adequate absorption and blood levels in the infant, but there is always uncertainty whether the drug is absorbed and oral therapy should not be employed in severe infections. If oral treatment is given, dosage of 50,000-100,000 units at intervals of 3-4 hours should be used, and the drug given on an empty stomach, followed by a feed 15-30 minutes later. It is usually wise to give extra vitamins, especially the B complex, during oral penicillin treatment.

Intramuscular penicillin may be used as 6- or 8-hourly injections of crystalline penicillin, or as daily injections of the delayed absorption preparations. The former is preferable and should be given in dosage of 25,000-100,000 units according to the severity of the infection.

Streptomycin.—Oral streptomycin is not absorbed from the gut and is used to sterilize the gut contents for operations involving the intestine. It has also been advocated for intestinal infections and, in the newborn, is employed in dosage of 50-100 mg. 6-hourly.

Intramuscular streptomycin is used in infections with gram negative bacilli and must be given by deep intramuscular injection in daily dosage of 10 mg. per pound body-weight divided into 2 or 3 doses.

Aureomycin, terramycin, and erythromycin.—These drugs have a wider spectrum of activity than either penicillin or sulphonamides.

The drugs are given by mouth and should always be combined with a high vitamin intake as they tend to sterilize the gut contents and interfere with vitamin synthesis and absorption. In the infant, diarrhoea may occur during the period of treatment.

The dosage to be used is based on body-weight and 12.5 to 25 mg. given daily for each kilogram of body-weight. The total dose is divided and given at 6- or 8-hourly intervals. The drugs may be given in syrup or glucose water to disguise the rather bitter taste. In severe infections tetracycline may be given systemically.

The Umbilicus

The umbilicus, or navel, loses importance as soon as the cord is tied. The residual stump of the cord desiccates and separates, usually by the 7th day, and leaves a raw area which heals by granulation. Until healing is complete the umbilicus represents an open wound which by its proximity to the napkin area may easily become infected.

Umbilical granulation.—When low grade infection of the navel is present, an area of proud flesh may develop and require treatment by cauterization with silver nitrate stick or antibiotic treatment locally.

Umbilical stickiness and moistness.—This is seen immediately after the cord separates and is best treated by applying a glycerine dressing or painting with 1 per cent. aqueous solution of gentian violet.

Umbilical infection.—Infection with a virulent organism may cause a spread of infection along the umbilical vein to the blood-stream with septicæmia, pyæmia, hæmolytic anæmia and jaundice. The infant becomes ill and shows general signs of infection, often with enlargement of the liver and spleen. The slightest suspicion of umbilical infection which has become generalized demands urgent treatment. A swab from the navel and a blood-culture to establish the nature and sensitivities of the infecting organism should be followed at once by full antibiotic therapy. The prognosis is serious.

Umbilical hæmorrhage may follow a slipped ligature or occur when the cord separates. Urgent hæmostasis is required and transfusion if the blood loss exceeds 2 ounces.

Anatomical Variations in the Umbilicus.—During early intra-uterine life the cord carried two umbilical arteries, a vein, and the stalks of the yolk sac and the allantois.

The skin of the abdominal wall invests the base of the cord for a short distance, and, when the cord separates, the skin dimples to form the navel. If the skin is carried on to the cord for a greater distance than is usually seen, separation of the cord leaves a protuberant cylinder of skin. This is called a *cutis navel*, but requires no treatment as the skin cylinder is absorbed into the abdominal wall with growth. It is often mistaken for an umbilical hernia. When the skin of the abdominal wall does not reach the base of the cord, a wide raw area is left which heals by granulation and fibrosis—the *amnion navel*.

Umbilical sinuses.—Persistence of the yolk sac or allantois may cause a discharging sinus at the navel.

Meckel's diverticulum.—Meckel's diverticulum may remain only as a blind sac on the wall of the small gut, or as a fibrous cord with or without enclosed cysts running between the small gut and the navel, or

may form a faecal fistula at the umbilicus. Pus or mucoid discharge may give way to faecal discharge.

The allantoic remnant may remain as a fibrous cord between the navel and the apex of the bladder, or as cystic swellings deep to the navel. Sometimes a persistent urachus produces a urinary fistula at the umbilicus. Surgical treatment is necessary.

Umbilical Hernia.—The gap in the rectus sheath through which the components of the cord enter the abdominal cavity can be palpated as a ring after the separation of the cord. Normally this ring closes down and restores the integrity of the rectus sheath. Persistence of the ring may permit a bulge of peritoneum with mesentery or gut enclosed and is an umbilical hernia. Surgical treatment may be required in later infancy, but only after a prolonged trial of cure by the use of wide zinc oxide strapping to hold the recti together and to keep the hernia reduced.

Exomphalos.—Exomphalos is a congenital defect of the closure of the abdominal wall. The infant is born with a deficient abdominal wall and the intestines are extruded, usually covered by peritoneum. The condition usually looks very grave, but, if no other gross congenital defect exists, the viscera should be covered with sterile dressings and surgical advice immediately obtained. It is often possible to repair the defect if the operation is performed at once and full antibiotic cover is given.

VARIOUS ABNORMALITIES IN THE NEWBORN INFANT

Dehydration (inanition) Fever.—Fever during the 1st week of life is often present without any evidence of infection. Dehydration fever is usually present between the 3rd and 5th days of life and the temperature usually reaches 100°-101° F., although it may rise as high as 105° F. and the infant become collapsed. The usual signs of dehydration are absent but the mouth and tongue are dry and the skin feels hot and is powdery.

The day on which fever appears usually coincides with the day of maximal weight loss. The condition is treated by giving the infant boiled water to drink by spoon in amounts of 1 ounce hourly until the temperature reaches normal. Occasionally it may be necessary to give a rectal or subcutaneous infusion.

The Infant of the Diabetic Mother.—The infant of the woman suffering from diabetes, even when the disease is well controlled by diet and insulin therapy, often shows macrosomia and may weigh

considerably above the average birth-weight. Babies weighing 9 or 10 pounds are not uncommon and may behave like premature babies despite their large size. The baby is very liable to cyanotic attacks and respiratory irregularities. Hypoglycæmia has been suggested as the cause of the high mortality rates found with these babies although the low blood-sugar levels which may be found do not fall outside the very wide range which occurs in normal babies (30-80 mg. per cent.).

The infants of diabetic mothers must be watched closely during the first few days of life and may require the administration of oxygen and extra warmth. It is sometimes advisable to give extra drinks of 5 per cent. glucose solution during the first day of life before milk feeding is begun.

Stridorous Breathing.—Laryngeal stridor may accompany inspiration in some newborn babies. It is worse with crying and quiets when the baby is asleep. There is often indrawing of the lower ribs and suprasternal notch. The cry is normal. The cause of the condition is debatable but it is usually attributed to congenital narrowing or smallness of the larynx, infolding of the epiglottis during inspiration, or to thymic enlargement. Laryngeal polyp or web is very rare but when doubt exists as to the cause direct laryngoscopy will often clarify the diagnosis. Unless a true obstructive lesion is present in the larynx there is no indication for treatment and the condition has usually resolved by the time the infant has reached the age of 18 months.

Mongols (Mongolian idiocy).—This condition can often be diagnosed at birth from the characteristic physical appearance of the infant. In other cases, although the appearance may be strongly suspicious, an element of doubt may remain and a definite diagnosis should be postponed until after an interval of some weeks.

The Male Genital System.—Delay in passing urine after birth may be seen for periods up to 24 hours and is usually not of pathological significance. Pressure above the symphysis pubis often results in the passage of urine. The first specimen often has a pinkish colour which is due to a high concentration of urates.

Abnormalities of the meatal orifice are seen and all degrees of hypospadias and epispadias may be met. In the milder degrees of hypospadias, it may be thought that the meatal orifice is not patent, but a careful search will reveal a minute orifice on the ventral surface of the corona or shaft of the penis through which urine is voided. In cases in which doubt exists, the patency of the meatal orifice, normal or ectopic, can be verified by the introduction of a sterile, well lubricated sound or catheter.

Hydrocœle may occur in the neonatal period, but requires no special treatment as the condition usually resolves spontaneously within a few days or weeks.

Circumcision.—This may be a ritual or a surgical operation. Ritual circumcision is practised in Jewish infants and is usually performed on the 8th day, the ceremony representing the christening of the infant. It is sometimes necessary to advise that the operation should be postponed if the infant is ill, jaundiced, or shows undue loss of weight. It is wise to give vitamin K 4 hours before the ceremony is performed, and to maintain a close watch for hæmorrhage for the 12 hours following the circumcision, which is not always performed by the usual surgical technique.

Non-ritual circumcision is not practised so frequently nowadays as it was in the past. Opinion as to the desirability of the operation is very widely divergent and the wishes of the parents often dictate whether the operation is carried out. Circumcision is indicated on medical grounds when phimosis is present in sufficient degree to embarrass micturition.

Routine retraction of the foreskin in the first week of life and the separation of præputial adhesions has been advised. If this is performed with too great zeal the prepuce may be torn and may bleed. In practice it is sufficient to ensure that urine can be passed without pain and otherwise no interference is necessary.

THE PREMATURE INFANT

The premature infant should logically be defined as a baby born before the end of the normal period of gestation. However, some full-time infants are small and immature and are subject to the same hazards to life as the prematurely born baby. A conventional standard of prematurity (and immaturity) has been adopted and all babies of a birth-weight less than $5\frac{1}{2}$ pounds (2,500 g.) are included in this classification.

These babies, by reason of their immaturity, are especially liable to suffer from intracranial hæmorrhage, infection, atelectasis and respiratory arrest, and difficulties in feeding.

The foetus is legally viable after the end of the 28th week of pregnancy, but with modern methods of treatment infants weighing as little as $1\frac{1}{2}$ pounds may survive.

Mortality-rate in Premature Birth.—The survival rate in premature babies is related to the cause of prematurity, the duration of pregnancy and most especially to the birth-weight and the resources

available for treatment will influence survival most significantly. Premature birth due to toxæmia or maternal illness diminishes survival rates, and in general the smaller the baby the less the chance of survival. The immature skull and poorly developed blood-vessels of the smaller babies increases the risk of intracranial hæmorrhage even when labour is uncomplicated.

General Principles of Treatment

1. To maintain body temperature.
2. To avoid infection.
3. To maintain adequate oxygenation.
4. To establish nutrition.

Babies weighing between $4\frac{1}{2}$ - $5\frac{1}{2}$ pounds at birth can be nursed satisfactorily at home, but the infant below $4\frac{1}{2}$ pounds is usually given a better chance of survival under institutional care. In many areas premature baby centres have been established for this purpose and on request a specially equipped ambulance and trained nurses will be sent out to transport the baby to the centre.

The past few years have brought very radical changes in the technique of care of the premature infant. The realization that these infants require a high humidity in the atmosphere, great freedom of movement to maintain vigour, and that they do not need early and full feeding, represent the major advances in technique. The use of antibiotics to combat infection has also lowered the mortality.

Home nursing should aim at reproducing in so far as possible the technique of the premature nursery, modified by circumstances and according to the weight of the baby.

Institutional Régime for Premature Infants.—As soon as respiration has been established, the infant should be placed in an incubator. Various types of incubators are available, but nearly all permit regulation of the internal atmospheric temperature, humidity and oxygen concentration. The infant is placed in the incubator quite naked and lying on a napkin. The incubator temperature is adjusted to a level which will keep the infant's temperature above 97° F. A humidity of 70° is desirable at first and oxygen is supplied as required. It is best that the oxygen concentration should be the lowest which will prevent any cyanosis and that oxygen administration is for as short a time as is essential. Vitamin K (synkavit) 1 mg. is given by injection and intramuscular penicillin, 50,000 units, is a valuable prophylactic during the first few days of life.

In the incubator the infant can be kept under observation and the respiratory passages immediately cleared of mucus if this should become necessary. All nursing services must be carried out by individuals wearing gown and mask. The premature infant in an incubator shows remarkable activities and moves the legs and arms, and indeed the

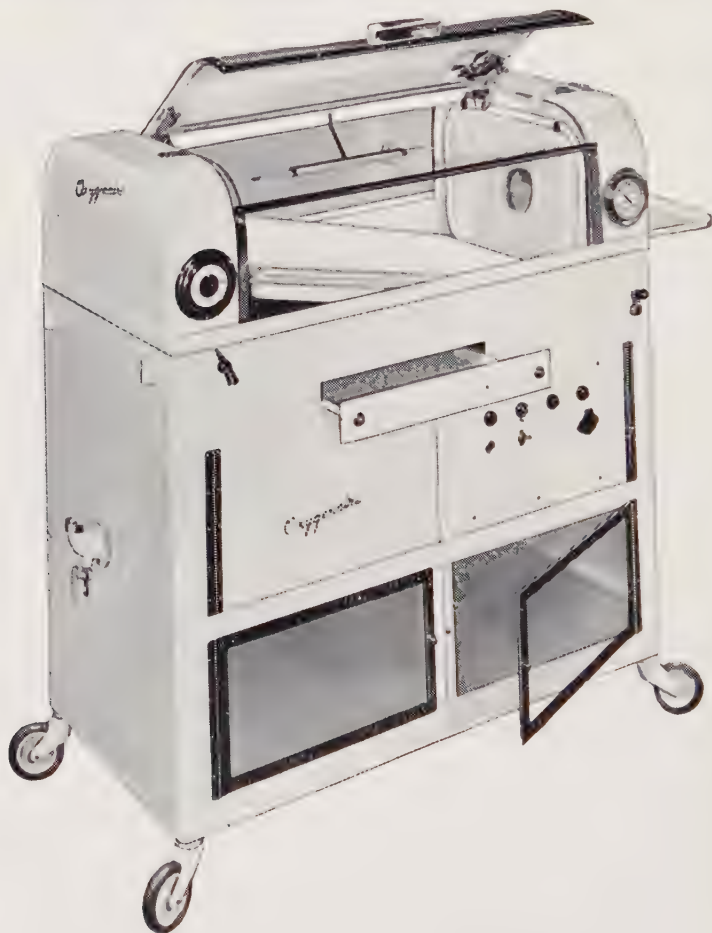


FIG. 258.—OXYGENAIRE INCUBATOR FOR PREMATURE BABY.

[Oxyginaire, Ltd.]

whole body, in a very free manner. The older technique of wrapping the infant in close swaddling blankets and shawls to maintain body heat hampers free chest and limb movements and diminishes respiratory and vascular function. The nudist technique in the incubator encourages the development of muscle tone and full expansion of the lungs.

Some years ago it was believed that the premature infant, because of low birth-weight and precarious hold on life, should be fed at an early stage and the feeds worked up to a high calorie intake as soon as possible.

The smaller premature infants have poorly developed sucking and swallowing reflexes and regurgitate food easily. Many deaths from inhalation of regurgitated feeds must have occurred through feeding too soon after birth and before the baby was ready.

Recently it has been shown that small babies can be left in incubators without feeds until the baby himself shows that he is ready and eager for food. The interval between birth and first feeding may

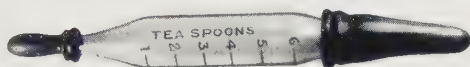


FIG. 259.—THE BELCROY FEEDER.

[John Bell & Croyden.

be as long as 24 to 100 hours. It has been said that "the infant should be left until his cries for food soften even the heart of a maternity ward sister". By the time he is ready to take food the muscle tone has improved and the liability to regurgitation has greatly diminished.

When feeding is started, a trial with a few drops of sterile water from a pipette should be made. Larger premature infants can both swallow and suck; smaller babies may be able to swallow but not suck; and the smallest infants of all can do neither. If swallowing and sucking are both absent, then tube feeds are necessary. When the infant can swallow but not suck, then feeds with a fountain pen filler will be satisfactory. Larger babies will take from a Belcroy feeder or from a bottle.

Feeds should be small and frequent and 2-hourly feeding may occasionally be required at first, but with increase in the size and strength of the baby, the size of feed and interval between feeding may be increased to 3-hourly.

The first feeds may be of 5 per cent. glucose and then a dilute milk feed given. Expressed breast milk affords the most satisfactory feed, but dried milks or evaporated milks may be used.

Experience in the nursing of premature infants alone will teach when the infant can safely be dressed and removed from the incubator, but each advance must be made gradually. From the incubator the infant should be moved to a warm nursery and then to a cool nursery.

Further details of the institutional nursing of premature infants should be sought in specialized text-books.

Jaundice in the Premature Infant.—The premature infant may show marked physiological jaundice due to liver immaturity. The serum bilirubin level may rise well above 20 mg. per cent. between the fourth and seventh days of life and there is a great risk of Kernicterus developing. The serum bilirubin level must be estimated and exchange transfusion may be required to keep the serum bilirubin under 20 mg. per cent.

Home Care of the Premature Infant.—In such circumstances, when there is no special nursery available with temperature, humidity and oxygen under mechanical control, it is necessary to improvise.

An ordinary cot, well padded around with blankets and with a screen around the head of the cot, will serve instead of the incubator and the temperature of the cot can be maintained by hot water bottles which are kept away from the infant by at least one layer of blankets.

The room temperature should be kept at about 75° F. by electric fires, steam radiators, or even a coal fire. The humidity may be kept reasonably high by hanging a damp towel over a steam radiator or in front of an electric or gas fire. The source of heat evaporates the moisture from the towel and moistens the atmosphere. The process may be made continuous by dipping the corner of the towel in a bowl of water.

Oxygen can be given during cyanotic attacks through a funnel placed over the face, or an oxygen tent may be hired in the larger cities.

It is essential to prevent infection and it is usually wise to keep visitors away from the infant until satisfactory progress has been established. The nurse or individual caring for the baby should wear a mask and, if possible, a gown when handling the infant.

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